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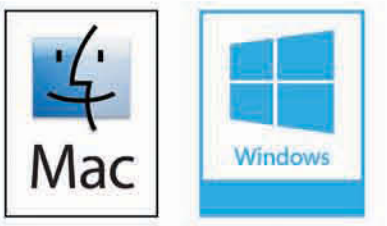

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Fine Homebuilding
DECEMBER 2015/JANUARY 2016 NO. 256

FEATURES

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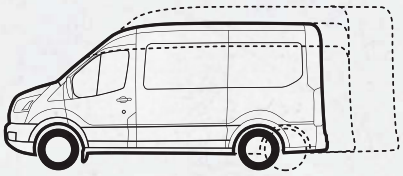
Our new digital editions include all of the magazine's content, plus searchability and a host of interactive extras. Download the app at FineHomebuilding.com/apps. Access is free with your print subscription or FineHomebuilding.com online membership.

INTRODUCING THE NEW FORD TRANSIT

The 2015 Transit can offer a best-in-class gas-powered maximum **CARGO CAPACITY OF 487.3 CUBIC FEET.***

THE MOST VEHICLE CONFIGURATIONS IN ITS CLASS.**



A WIDE VARIETY OF DIMENSIONS

The Transit van and wagon are available in 2 different wheelbases, 3 different lengths and 3 different heights. That makes it easy to choose one that will fit you and your business exactly. And if that's not enough, it's also available as a chassis cab and cutaway.

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*Class is Full-Size Vans, when properly equipped. Excludes diesel competitive models. **Based on body type, body length, and wheelbase and roof height. Class is Full-Size Vans. †When properly equipped.

IN EVERY ISSUE

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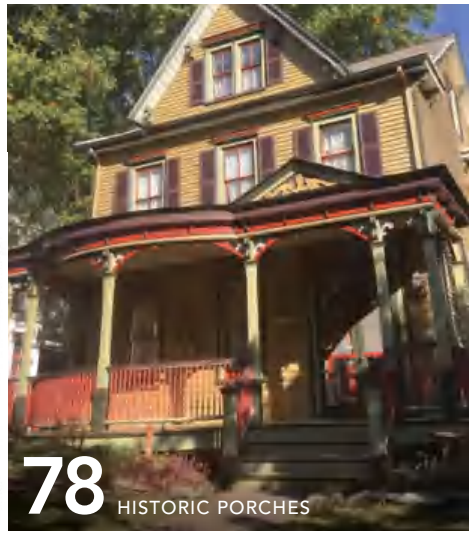

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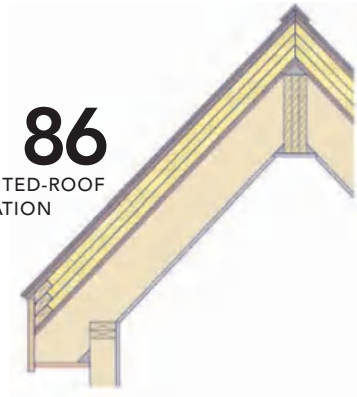

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98 PARKING PAVILIONS

The Taunton Press
Inspiration for hands-on living®

ON THE COVER: Trim carpenter Nick Schiffer demonstrates the forgiving flexibility that makes two-piece baseboard molding such a great solution. His article on installing this molding is on pp. 32-37. Photo by Justin Fink.

Why would you select cabinetry from Crown Point?

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- Custom Builder; Montclair, NJ

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"I absolutely love how everything turned out and want to tell you all again how much I appreciate everything you and Crown Point did to make this come together. I hope to work with you again soon on other house projects we have coming up this year."

-Remodeler; Delmar, CA

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VIDEO: Behind the Scenes With *Fine Homebuilding*

If you've ever wondered how we fill the pages of the magazine, then you won't want to miss our new video that gives a close-up look at a job-site photo shoot. Project House editor Justin Fink shares his experiences from being on the road and what it's like to work with our talented authors. You'll even get a glimpse of his shoot for the "Perfect Roof Rafters" article that appears on pp. 68-71.

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SLIDE SHOW: All About Ice Dams

It's that dreaded time of year again when our worst insulation and air-sealing fears materialize as ice dams on our roofs. Ice dams are common with inadequately insulated and air-sealed homes in cold climates, and they can be the culprit behind major problems. This slide show provides all the information you need to know about what causes ice dams and how to prevent them.

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breaktime

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Rim-joist insulation

JIMMIEM ASKS: A few years ago, I had an energy audit done by an affiliate of my utility company. The recommendation for insulating the rim joist was to use spray foam. The affiliate would share the cost or pay for it all, depending on the insulation project, but I did not have the work done at that time. I contacted the affiliate recently to ask if the contract was still valid. Due to the time lapse, I was told that I would have to have my home audited again. Following the second audit, the recommendation was to use fiberglass to insulate the rim joist in conjunction with air-sealing. Has something changed with spray foam vs. fiberglass?

Mongo replies: If you need air-sealing, you're not going to get it with fiberglass, even if it's faced. I recommend using foam—spray foam if it's contracted out. It's faster and will fill around all the nooks and crannies. If you're doing the job yourself, you can use rigid-foam sheets, either friction fit or undercut and then secured with canned foam or its equivalent. Or you can buy tanks of foam and spray your own.

Last fall, I insulated my rim joists with two layers of 2-in. XPS (R-20) installed with a friction fit. The job went faster than I thought it would, and the pieces of foam installed tight as a drum. I had a few bays with electrical or plumbing obstacles that I detailed by cutting slightly oversize holes for the penetrations and then filling them with canned foam. I ripped the XPS to size with a tablesaw, then used a multitool to cut notches in the corners for the I-joist flanges. I used a utility knife for fine-tuning when fitting. Because the foam pieces were friction fit, I'd start them with my hands, then pound them in place with a hammer and a piece of 2x4 or 2x6 on the flat to distribute the force.

AndyEngel adds: I'm more a fan of undercutting and filling the gaps with expanding foam, but Mongo's approach is fine, too.

Photos: top, Colin Russell; bottom, Paul Fisette

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THE VOICES OF EXPERIENCE

STEVE DEMETRICK ("Detailing Walls With Rigid Foam," pp. 38-41) is the owner of DeMetrick Housewrights, a residential building company in Rhode Island that specializes in high-performance building, millwork, and high-end remodeling. A certified Passive House contractor, he just completed the first certified Passive House in Rhode Island. When he's not air-sealing European windows or making custom stair parts, Steve enjoys life with his wife and children.

A service coordinator for Perfection Wholesale Supply in Houston, **JAMES CLELAND** ("Guide to Gas Fireplaces," pp. 50-53) is certified in gas fireplaces by the National Fireplace Institute (NFI). During his 16 years in the hearth industry, he has taken numerous educational and troubleshooting classes, as well as courses for maintaining his NFI certification. In his free time, he and his wife enjoy cheering on their two teenagers at athletic events.

SAM KOERBER ("Perfect Roof Rafters," pp. 68-71) is a second-generation builder from Asheville, N.C. He grew up working with his father, uncles, brother, and cousins and now runs KOR Construction, a company that focuses on new homes in the Asheville area that aim to blend the old with the new and bring together great design, craftsmanship, and art. He dreams of someday buying a camper and taking a long vacation with his family.

NICK SCHIFFER's passion for carpentry began in childhood. Just before her kitchen floor was to be replaced, his grandmother gave him a hammer and a box of nails and let him pound away. Nick went on to work for his father's residential fence company and then as a project manager for a developer of high-rise buildings. He now owns NS Builders near Boston. His article on installing two-piece baseboard is on pp. 32-37.

write an article

Fine Homebuilding welcomes articles from our readers. We'll acknowledge all proposals and return any we can't use, and we'll pay for any articles we publish. For details, check our website at FineHomebuilding.com.

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letters

READER FEEDBACK

IN THE SPOTLIGHT

Track-saw safety

I've just finished reading the article "Track Saws" by Doug Mahoney (*FHB* #254). Several things stand out to me:

• The author is using two track saws with the blade plunged to the maximum possible depth on material that is nowhere near that thick. This is inherently dangerous unless the user is doing stopped plunge cuts.

• Clamping the rail is not necessary when making cuts but is advisable to prevent the rail from subtly wandering during long cuts, especially in sheet goods.

• In my experience, when joining two sections of track, it is good practice to use a 4-ft. or 6-ft. level—or better yet, the Betterley StraightLine Connector—while you're tightening the track-connector screws to get the two sections of guide rail perfectly aligned. The guide-rail ends are not cut as precisely as one might wish; as such, they may produce an imperfect alignment of the two sections of track.

—WILLY WILLIAM
via e-mail

Track-saw correction

I enjoyed reading the October/November 2015 issue of *Fine Homebuilding*. Regarding the review of track saws, however, I wanted to offer a correction about the DeWalt saw. More than once the author noted that there is not a track connector for the DeWalt saw, which seemed to be his primary complaint with that tool. I thought this was odd because I have one. Also, DeWalt sells three track sizes (46 in., 59 in., and 102 in.), not two as stated by the author.

—MARTY BACKE
Downey, Calif.

Associate editor Patrick McCombe replies: Thanks for your letter about the recent track-saw tool test. You are correct in that we did not mention DeWalt's 46-in. track. However, the track connector you referred to is no longer offered, a fact I confirmed with the company.

High on performance, low on practicality

With all due respect to Joe Lstiburek, a brilliant building scientist and a preeminent energy-efficiency pioneer, I would not touch his ideal double-stud wall ("Energy-Smart Details," *FHB* #255) with a 10-ft. pole. It's colossally stupid to put the second (nonstructural) wall outside the first (structural) wall because there's no easy way to support it at the foundation and because it's a framing/sequencing nightmare. In terms of the physics, it's great, but in terms of practicality, I would be very surprised if anyone has built this type of wall. So what's the point?

If builders want a wood wall with an ideal vapor profile for a cold climate, they would be

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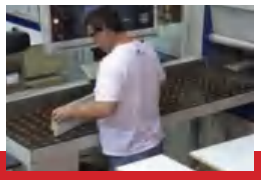

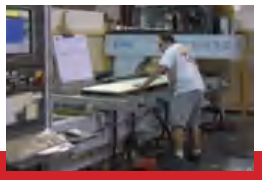

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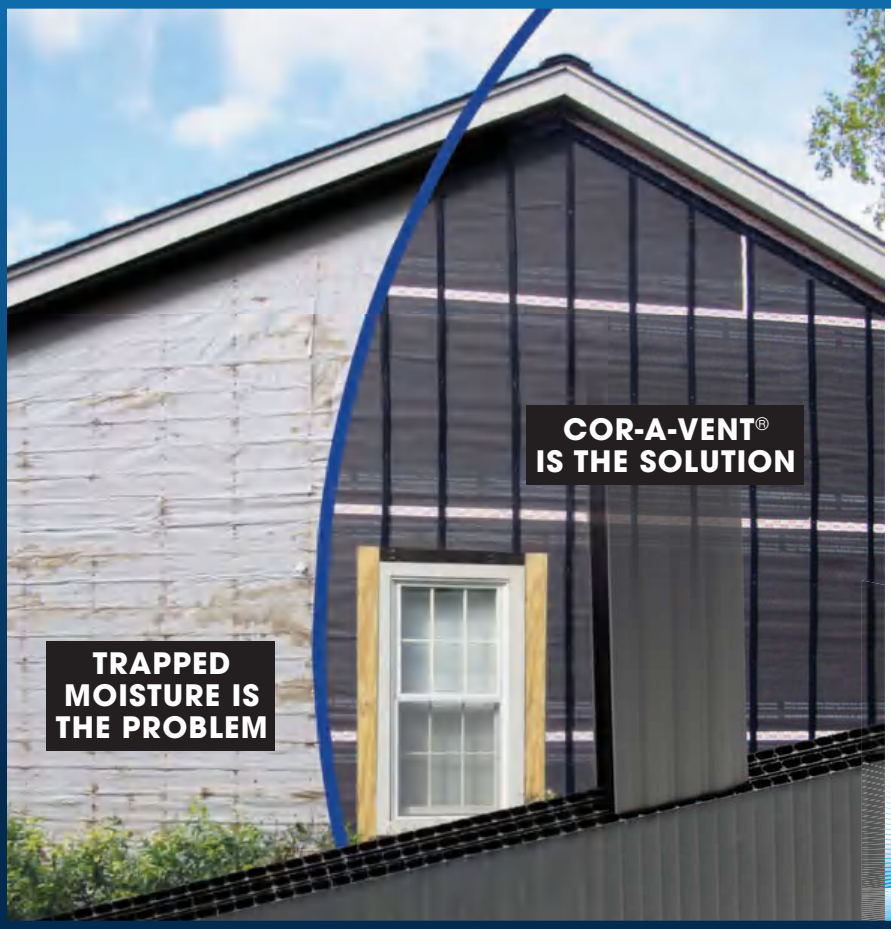

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much better off building the Larsen-truss wall, with wood I-joists hung from the outside of a conventional wall assembly.

—DAVE BRACH, RA, CPHC
Salt Lake City

Obsolete bits

Regarding the "What's the Difference?" piece on Phillips and Pozidriv bits (*FHB* #254), I find it hard to believe that contractors, electricians, and anyone else facing hand-driven or power-driven screws on a daily basis still put up with these impractical four-slot bits and fasteners. The square, Robertson-drive system won the efficiency race over a century ago. It's time to bring U.S. industry out of the dark ages.

—DAVID FRANKLIN
via email

Ease up on efficiency

I'm a longtime subscriber to your magazine and always enjoy when it arrives in the mail. I do feel, however, that your name should be changed to *Fine Home-insulating,* since that seems to be your main focus now. What was once a nice addition to all the other articles has completely taken over. You need to take a step back and get some balance back into the magazine.

—LOUIS FRANCHINO
via email

Trim torture test

I just read your article "Choosing Exterior Trim" by Gary Katz (*FHB* #253). I don't know what the boys in the labs do to test their products, but here's what I did to test out MiraTEC trim. I brought a sample from the local lumberyard to a job site in February 2006 and put it in a bucket of water outside with a brick on top. Six weeks later I removed it from the water, expecting to have a handful of mud or sawdust as with some other popular trim pieces. Although it had swelled to a thickness of 1 in., it was still solid. I then threw it on the dirt at the back of the job site and left it for over four months. Finally, I brought the piece (which had shrunk to its original ¾-in. thickness) home, bored a hole in it, and tied it to the handrail of my deck with a coat hanger. Over nine years later, it's as strong as it was when I first got it. I purchased some of this trim for a cabin in Tennessee just outside the Smoky Mountains, with the expectation that it will be around and in good shape long after I'm gone.

—MICHAEL GADBOIS
via email

Small-home inspiration

Last spring we completed construction on our new lake home. It was inspired 100% by your special *Small Homes* issue. We were amused to witness how negatively local real-estate agents received our home, as their mindset is so closely tied to square footage. However, we love our home—its simplicity and unique small inspirations.

—VINCENT DAVIS and SCOTTY JONES
via email

your safety

Home building is inherently dangerous. From accidents with power tools to falls from ladders, scaffolds, and roofs, builders risk serious injury and even death. We try to promote safe work habits through our articles. But what is safe for one person under certain circumstances may not be safe for you under different circumstances. So don't try anything you learn about here (or elsewhere) unless you're certain that it is safe for you. Please be careful.

—ROB YAGID
editor

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Photos: top, courtesy of Vincent Davis and Scotty Jones; bottom, courtesy of Michael Gadbois

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THE MECHANICS OF HOME BUILDING

Ice

What do northerners from North Dakota to Maine call the period between Valentine's Day and Easter? Ice-dam season, of course.

During snowy winters, many northern homes are plagued by ice dams, which form when escaping heat warms the roof sheathing and melts the underside of the snow layer on the roof. As the melted water refreezes at the eave, the resulting dam interferes with drainage. Water can then back up, get under the roofing, and lead to interior damage.

Although the impulse of many homeowners is to respond to a water leak by calling a roofer, leaks from ice dams are just a symptom of a larger problem that usually stems from air leaks or insulation defects.

Sealing the roof eaves with flashing membranes adds extra insurance against ice dams. In a few rare cases, increasing the amount of roof ventilation may help. However, air-sealing the connection between the living space and the roof or attic and then improving insulation is usually the best way to solve the problem.

The best course of action is to ignore the contractors who talk about roof repair and ventilation improvements and instead find a home-performance contractor who knows how to identify air leaks using such tools as a blower door, an infrared camera, or a fog machine. But before you call anybody, it helps to have a good understanding of what causes an ice dam to form. Here's how it works.

Martin Holladay is a senior editor.

How ice dams form

1. Warm interior air entering an attic (or roof assembly in a cathedral ceiling) raises the temperature of the roof sheathing, causing the underside of the snow to melt.

2. Water trickles down the roof until it reaches the eave—which is significantly colder than the rest of the roof—where it refreezes.

3. This recurring process causes the ice at the eaves to get thicker and thicker, forming an ice dam.

4. Eventually, water from melting snow backs up behind the ice dam. If the water reservoir is large enough, it can seep up under the roof shingles, leak through the roof sheathing, and cause damage.

Drawings: Christopher Mills

dams

BY MARTIN HOLLADAY

How to fix them

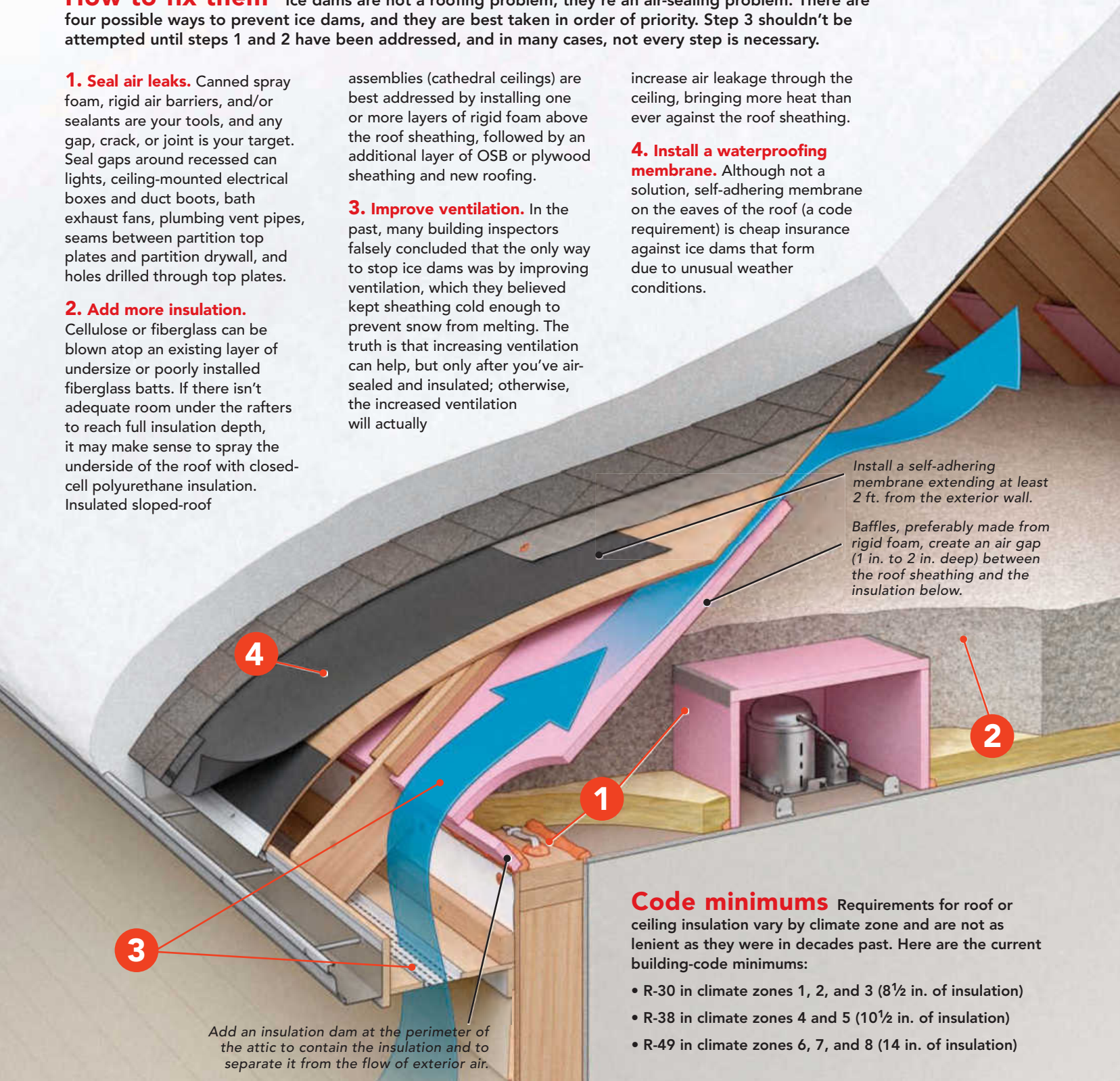
Ice dams are not a roofing problem; they're an air-sealing problem. There are four possible ways to prevent ice dams, and they are best taken in order of priority. Step 3 shouldn't be attempted until steps 1 and 2 have been addressed, and in many cases, not every step is necessary.

1. Seal air leaks. Canned spray foam, rigid air barriers, and/or sealants are your tools, and any gap, crack, or joint is your target. Seal gaps around recessed can lights, ceiling-mounted electrical boxes and duct boots, bath exhaust fans, plumbing vent pipes, seams between partition top plates and partition drywall, and holes drilled through top plates.

2. Add more insulation. Cellulose or fiberglass can be blown atop an existing layer of undersize or poorly installed fiberglass batts. If there isn't adequate room under the rafters to reach full insulation depth, it may make sense to spray the underside of the roof with closed-cell polyurethane insulation. Insulated sloped-roof assemblies (cathedral ceilings) are best addressed by installing one or more layers of rigid foam above the roof sheathing, followed by an additional layer of OSB or plywood sheathing and new roofing.

3. Improve ventilation. In the past, many building inspectors falsely concluded that the only way to stop ice dams was by improving ventilation, which they believed kept sheathing cold enough to prevent snow from melting. The truth is that increasing ventilation can help, but only after you've air-sealed and insulated; otherwise, the increased ventilation will actually increase air leakage through the ceiling, bringing more heat than ever against the roof sheathing.

4. Install a waterproofing membrane. Although not a solution, self-adhering membrane on the eaves of the roof (a code requirement) is cheap insurance against ice dams that form due to unusual weather conditions.



Code minimums

Requirements for roof or ceiling insulation vary by climate zone and are not as lenient as they were in decades past. Here are the current building-code minimums:

- **R-30 in climate zones 1, 2, and 3 (8½ in. of insulation)**
- **R-38 in climate zones 4 and 5 (10½ in. of insulation)**
- **R-49 in climate zones 6, 7, and 8 (14 in. of insulation)**

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EDITED AND ILLUSTRATED BY CHARLES MILLER

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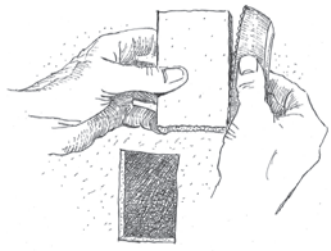
Drywall patch

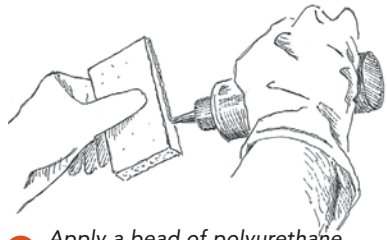
To repair a hole in drywall or plaster, I square up the hole, cut a drywall patch slightly larger than the hole, and use a Surform file to size the patch for a friction fit. Then I apply a bead of polyurethane glue to the edge of the patch before slipping it into place slightly below the surface of the wall. After a few minutes, the glue foams up and fills the gap between the patch and the wall. Polyurethane glue is activated by moisture, so slightly wetting the edges of the drywall makes the glue foam even more and fill the gap more fully. Gloves are essential, as it takes weeks for the glue to wear off.

When the glue has set, I use a paint scraper to knock off the bulk of the hardened glue before sanding the surface flush with an orbital sander. Because polyurethane glue is brittle when cured, it is easy to scrape and sand. I use drywall compound over the patch and mesh drywall tape on the seams. The tape is insurance against joint failure, but on some jobs, I have eliminated the tape and haven't had any problems with cracks at the joints.

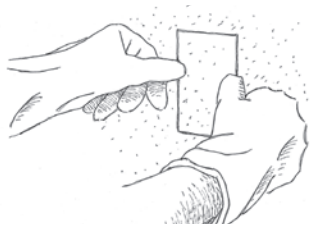
—JOE RABBITT
Streator, Ill.



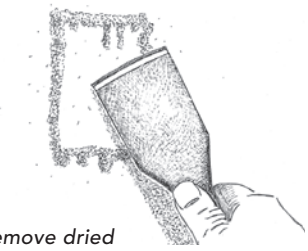
1 *Shape the patch with a metal Surform file.*



2 *Apply a bead of polyurethane glue to the patch.*

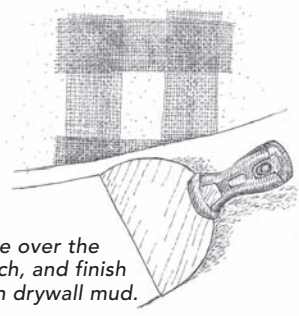


3 *Set the patch slightly below the surface of the wall.*



4 *Remove dried glue with a paint scraper.*

5 *Use a sander to remove the remaining bits of glue.*



6 *Tape over the patch, and finish with drywall mud.*

submit a tip

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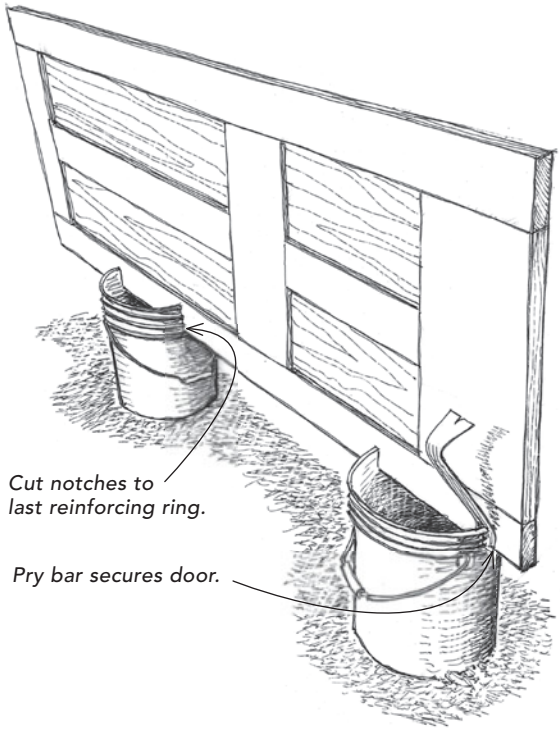

Drywall-bucket door rest

I had to plane the bottom of some bedroom doors that dragged on a shag rug, but I didn't have my portable workbench to hold the doors on edge. Needing a quick solution, I cut some notches in two empty drywall-compound buckets down to the last reinforcing ring and placed one of the doors on edge right in the notches. To hold the door tight, I inserted a flat bar between the door and one of the notches. This setup was remarkably stable, especially after I added weight to the buckets.

—JAMES FISK
Kennebunk, Maine

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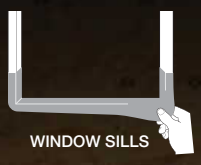

WINDOW SILLS

WALL PENETRATION

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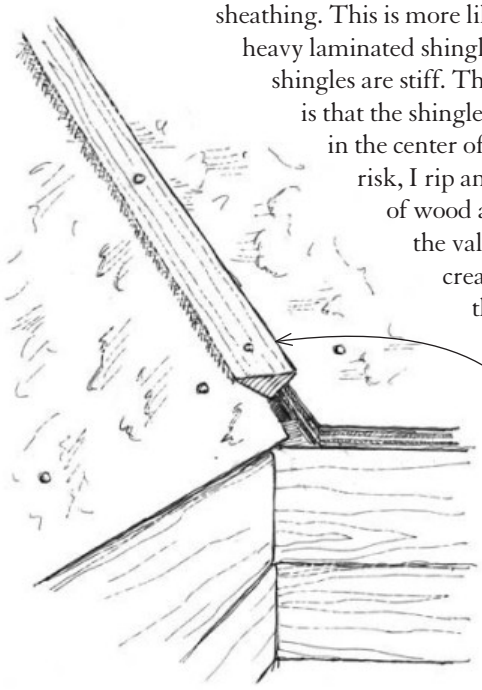
CONTINUED

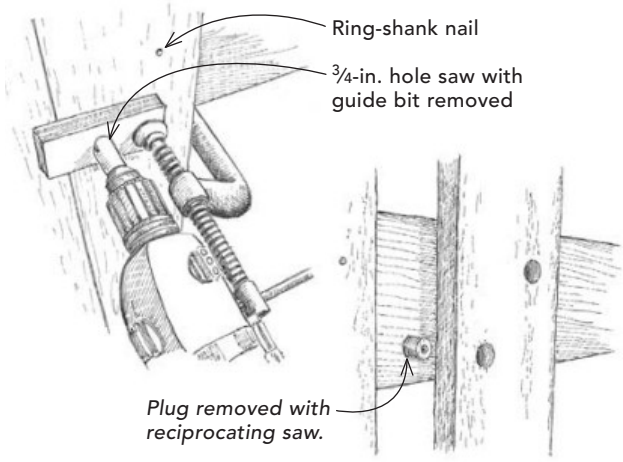
Reinforced valley-rafter shingles

Asphalt shingles often don't bend tight enough to sit flat in the center of a roof valley, which leaves an unsupported hollow between the shingles and the roof sheathing. This is more likely to occur when using heavy laminated shingles or in cold weather when shingles are stiff. The risk with the hollow spot is that the shingles can split if a worker steps in the center of the valley. To reduce that risk, I rip an angled fillet from a 2x strip of wood and fasten it in the center of the valley. The fillet eases the sharp crease of the valley center so that the shingles have support.

—MIKE GUERTIN
East Greenwich, R.I.



Made from 2x, this strip virtually removes the chances of damaging shingles with a misplaced step.



Removing fence boards

I needed to remove some poorly installed cedar fence boards that were secured with ring-shank nails, but I didn't want to damage them with a pry bar. I cut a hole in a small scrap of wood with a ¾-in. hole saw to make a template, then removed the guide bit from the hole saw. I clamped the template with the hole centered over each nail, then used the hole saw to cut a plug around the nail. After sliding the fence boards off all of the plugs, I used a reciprocating saw with a metal-cutting blade to cut the plugs free of the rails. I reinstalled the boards with new fasteners and glued the plugs in place.

—STEPHEN BEESE
Winston-Salem, N.C.

ISSUE 174 // 2005

TIP FROM THE ARCHIVES

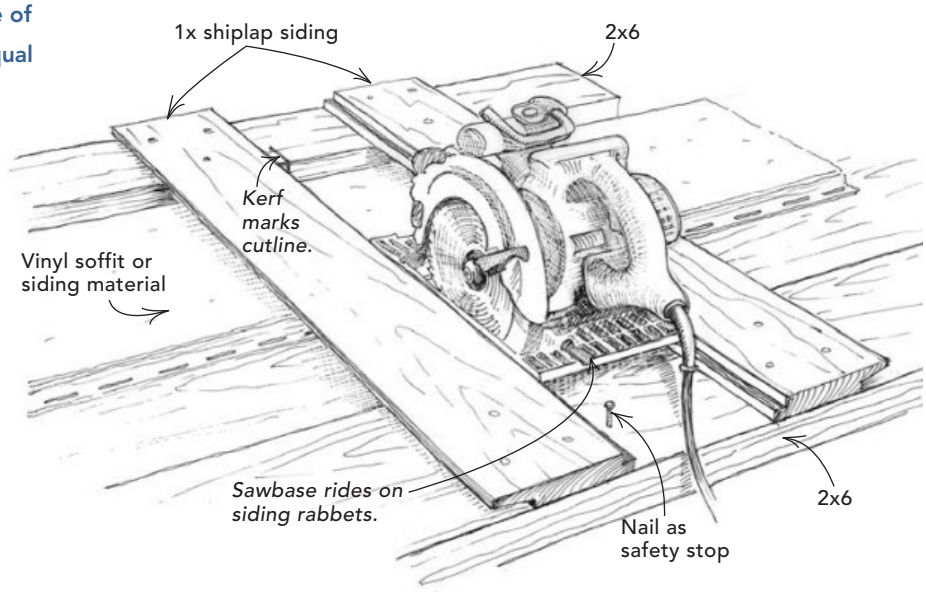
A site-made saw guide for cutting vinyl

Cutting vinyl soffit and siding material can be done quickly and accurately with a saw guide, and the jobs I work on usually have a commercially available guide on-site. But once in a while, the saw guide goes missing, and we have to improvise.

On a recent job with much vinyl to cut and no saw guide, I noticed a few scraps of 1x6 shiplap siding on the burn pile. I cut two pieces 33 in. long and, with their rabbeted edges facing one another, laid them upside down atop a couple of 2x6s. With the 1x6 pieces set at a distance equal to the width of my saw's base, I screwed them to the 2x6s. This setup made a nifty little slide guide for cutting vinyl siding or squaring 1x or 2x stock.

The sawkerf in the far 2x6 indicates the cutline. In the near 2x6, a nail acts as a safety stop to keep the saw from accidentally backing out of the guide.

—WILL RUTTENCUTTER
Valdosta, Ga.



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Ultracompact framer

A framing nailer is one of the most vital tools in a carpenter's arsenal. These nailers are typically bulky and heavy, though, so carpenters often resort to hand nailing or using a palm nailer when working in close quarters. That may all change with Paslode's most recent entry in the framing-nailer market. The new F325R compact framing nailer ($269) was designed with remodelers in mind.

The first thing I noticed about this new tool was how light it is. The F325R weighs just under 6 lb. There's a tradeoff for reduced weight, however: reduced capacity. The F325R holds only one stick of nails, or about 42 shots. I found the lower capacity to be a nuisance at first in production-style framing such as rolling trusses or nailing sheathing. But after a few hours of use, I got into the rhythm of more frequent reloading. At the conclusion of the day, I was happy I had carried more nails in my belt instead of at the end of my arm.

Of course, my crew and I had to give the F325R the standard test of framing-nailer power: nailing LVLs. Out of the 42 nails we shot, not one was left proud, an indication that Paslode did not compromise power in reducing size. I also had a chance to use the tool to nail blocking and studs in a shower bay during a bathroom remodel. Here, closer to its intended purpose, the F325R really started to shine. At just 13 in. long, it fit in every bay, box, or hole we could think to stick it in. It easily toenailed the blocking in the 12-in. on-center stud bays, as well as the studs themselves. As we expected, the reduced weight made overhead nailing much more tolerable than it would have been with a conventional framing nailer.

The F325R does have a few downsides. Although it can be switched from sequential fire to bump fire, you have to remove a near microscopic O-ring to do that. I figure that my odds of finding and reinstalling this O-ring on a dusty, dirty job site are slim to none, so I didn't even attempt it. Paslode touts the tool as having a "quick 2-step nail strip reload," but I found the process to be a little less than intuitive at first.

Also, as with all Paslode nailers, an air fitting is not included. When I get a new nailer, I want to put it right into service, not go looking for fittings and thread tape. I would gladly pay $5 more to have it ready to go straight from the box.

As a full-time remodeler who does very little production framing, I will only ever need the F325R. Its light weight and balance offer a welcome respite for an aging right arm. I'm afraid it has relegated my former framing nailer to second string.

Andrew Grace, a remodeler in Ligonier, Pa.

Easy rain screen

Benjamin Obdyke's Home Slicker was the first plastic membrane designed for creating a ¼-in. ventilated airspace behind siding. At first, builders had to install housewrap or some other water-resistive barrier (WRB) before installing the plastic spacer. A few years later, Benjamin Obdyke released Home Slicker with Typar, which includes a WRB attached to the back side of the plastic mesh. This product saves labor compared to the original Home Slicker, but there's a drawback: It's difficult to separate the housewrap from the mesh, so it's tougher to integrate flashing and transition details.

A new product, Slicker HP, solves this problem. The mesh is attached to Benjamin Obdyke's own WRB with an easy-to-separate adhesive, making it easier to integrate flashing details. It sells for about $2 per sq. ft.

Patrick McCombe, associate editor

Photos this page: top, courtesy of Paslode; bottom, Dan Thornton

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Sweet tile tools

As a remodeler who tiles infrequently, I rely on Hart's Quick-Tatch seven-piece kit, which includes three stainless-steel trowels (two square-notch and one V-notch), a rubber grout float, and a small rugged case. The trowels and the float share a handle that locks onto each tool's spine. The attachment is positive and secure anywhere along the spine, so you can set up the notched or straight edge of the trowel for either left-hand or right-hand use, which is great for working in tight spaces. The case prevents the trowels from getting bent (unlike the 5-gal. buckets I've used in the past), keeps all my tiling tools in one place, and has drain holes, so it also serves as a drying rack. At $40, the kit is a bargain. It helps me stay organized and saves space in my truck. There's also a three-piece kit (HQTC020; $15), which includes a handle, a ¼-in. square-notch trowel, and a rubber grout float. Extra blades sell for $6 and $8. Grout pads sell for $9. All the tools have a lifetime guarantee.

Sean Groom, contributing editor

Top-shelf top loader

Although front-loading washers were all the rage for more than a decade, their popularity has declined in the last few years. According to sales-tracking firm TraQline, top loaders are currently outselling front-loaders by a margin of three to one—a big change from 2009, when just 45% of the washing machines sold were top loaders. The reason for the decline could be price, as the average front loader costs $200 more than the average top loader. Other possible explanations are that early front loaders didn't clean as well as the top-loading machines they replaced and vibrated so badly during spin cycles that people complained of rattled china and units occasionally skittering across the room.

As part of this resurgence in popularity, GE has launched a new line of top-loading washers and matching dryers. Most notable is the GTW485ASJ, which at 4.2 cu. ft. is the largest Energy Star–rated agitator washer on the market. The matching dryer, the GTD45EA (electric), boasts a capacity of 7.2 cu. ft. Each machine sells for $649. The gas-powered dryer, the GTD45EA/GASJ, sells for $749. Both dryers also are Energy Star rated.

P.M.

The best connector nailer

I've found few things in life that save as much time and effort as the Strapshot MCN 150 from Bostitch. This purpose-built metal-connector nailer transforms fastening joist hangers, hurricane straps, and other metal building hardware from a mind-numbing, physically taxing job into an efficient and relatively easy task. Although the tool has been around for almost 10 years, I was recently reminded of how well it works when I was faced with installing 40 joist hangers for a new deck. Because the tool has such a small housing (it's 10½ in. tall), it can fit in joist and stud cavities as small as 12 in. wide. It's light, too; at under 5 lb., it's about the weight of a 15-ga. finish nailer. It has a dry-fire lockout, and its magazine holds 29 nails. There's also a rotating hook near the air fitting for hanging the tool from a belt or a framing member.

Somewhat notable in the world of metal-connector nailers, the Strapshot uses the nail itself for hole location, which works well. Including setup, it took me an hour to install my forty hangers, and my arm felt fine the next day. I suspect that nailing them by hand would have taken twice as long, probably longer, and that my middle-aged arm would have been ringing from the effort. The Strapshot MCN 150 drives 1½-in. nails and sells for

$200. A similar tool, the MCN 250, drives nails from 1½ in. to 2½ in. and sells for $280. A box of 1000 1½-in. bright nails for interior applications is $35. Galvanized nails for outdoor use are $55.

P.M.

Photos this page: courtesy of the manufacturers

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what's the
HELPING READERS MAKE CHOICES

difference?

RESILIENT FLOORING

Linoleum vs. vinyl

Flooring options abound—even the options have options. But if you're looking for inexpensive flooring, especially in a potentially wet area such as a kitchen or bathroom, you're probably going to consider linoleum and vinyl. Although the terms are often used interchangeably, these materials are not the same. The mention of either sometimes conjures up images of second-rate products, but both have their place.

Linoleum and vinyl fall into the category of resilient flooring. According to Michele Zelman of Armstrong, which makes flooring products out of both materials, to call a flooring material resilient means that it can restore its shape. If a heavy object were to land on it, the material wouldn't necessarily be permanently dented. Linoleum is mostly, but not exclusively, limited to commercial applications. Vinyl is found in numerous residential and commercial applications. Both materials are available in sheets and in tiles.

Matt Higgins, assistant editor

LINOLEUM

First patented over 150 years ago, linoleum is an older product than most people realize, and like many innovations, it was discovered by accident. English inventor Frederick Walton observed how a solid but flexible film formed on top of linseed-oil-based paint. He experimented with this natural product and eventually found it to be a perfect floor and wall covering. Since linseed oil was the primary component, Walton called his new product linoleum.

Another important characteristic of linoleum that is largely unknown—but far more relevant to current home-building trends—is that it's all natural and biodegradable. In addition to linseed oil, linoleum includes pine rosin, limestone, cork flour, wood flour, jute as the backing, and coloring pigments. Its color goes through to the backing, so scratches don't readily show. Homeowners increasingly are selecting it as a green material that is relatively inexpensive.

Linoleum must be installed over a clean, smooth, and level surface, as imperfections in the floor can cause bumps. If the surface can't be smoothed, an underlayment may be needed. Linoleum is cut with a utility knife or a heavy-duty curved linoleum knife. Typically, it's secured with flooring adhesive, and depending on manufacturer specifications, a 100-lb. roller may be used to promote strong adhesion. Seams on some products can be heat welded. Rigid click-together tongue-and-groove tiles are also available that install over a thin foam underlayment without any adhesive or fasteners. These tiles typically are cut with a jigsaw.

Linoleum isn't as flexible as vinyl, and it is more difficult to cut. There are also fewer color options with linoleum, and the material isn't used nearly as widely as vinyl. New linoleum also has a temporary yellow cast called bloom that eventually disappears when exposed to light.

Linoleum requires only basic routine care such as sweeping and mopping with a product-specific pH-neutral cleaner, but the flooring must be polished with a sealer once or twice a year because the surface is porous.

Cost

TILE $4 to $10 per sq. ft.
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Deep color. *Because the color goes through to the backing, scratches don't readily show on linoleum.*

Product photos: Dan Thornton. Installation photos: courtesy of Armstrong.

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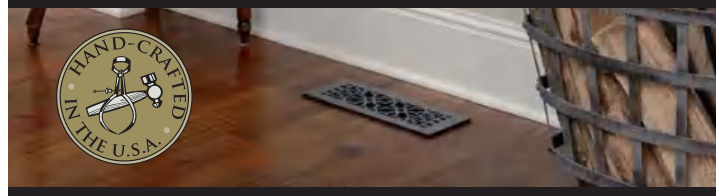

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VINYL

Vinyl was also discovered accidently. Waldo Semon created it in the late 1920s while attempting to develop a glue for bonding rubber to metal. Today, vinyl is, of course, used in a huge variety of applications.

Even though they are often confused and can look similar once installed, vinyl and linoleum are significantly different in terms of composition. While linoleum is all natural, vinyl is a synthetic product made using a variety of toxic chemicals, primarily polyvinyl chloride (PVC) resin. Sheet vinyl flooring also contains plasticizers for flexibility. Vinyl's large market share comes with a huge number of color and pattern options. Also, not all vinyl flooring is inexpensive. Luxury vinyl flooring (LVF, or LVT for tiles) is a higher-quality version of the product.

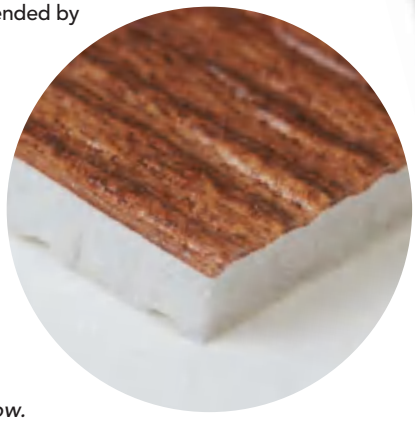
Like linoleum, vinyl flooring is available in sheets and tiles that get installed with flooring adhesive. A 100-lb. roller is often used, and the seams on some products can be heat welded. There is also a large selection of self-adhesive peel-and-stick tiles. Vinyl flooring is cut with a knife or shears, and since it generally is thinner and more flexible than linoleum, it's easier to cut.

Vinyl's color and patterns are printed, which allows for a tremendous variety and keeps costs low. It also means that deep scratches may show, since the color and patterns don't always go through to the backing.

Vinyl flooring requires no special care. In most cases, a mild cleaner is recommended by the manufacturer.

Cost

TILE $1 to $10 per sq. ft.
SHEET $7 to $45 per sq. yd.



Printed surface. *Vinyl's surface is inexpensive to produce and allows for great variety, but scratches can show.*

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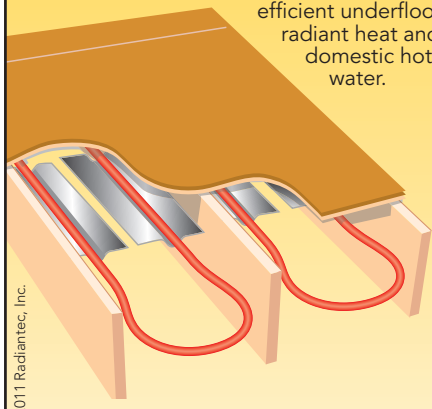

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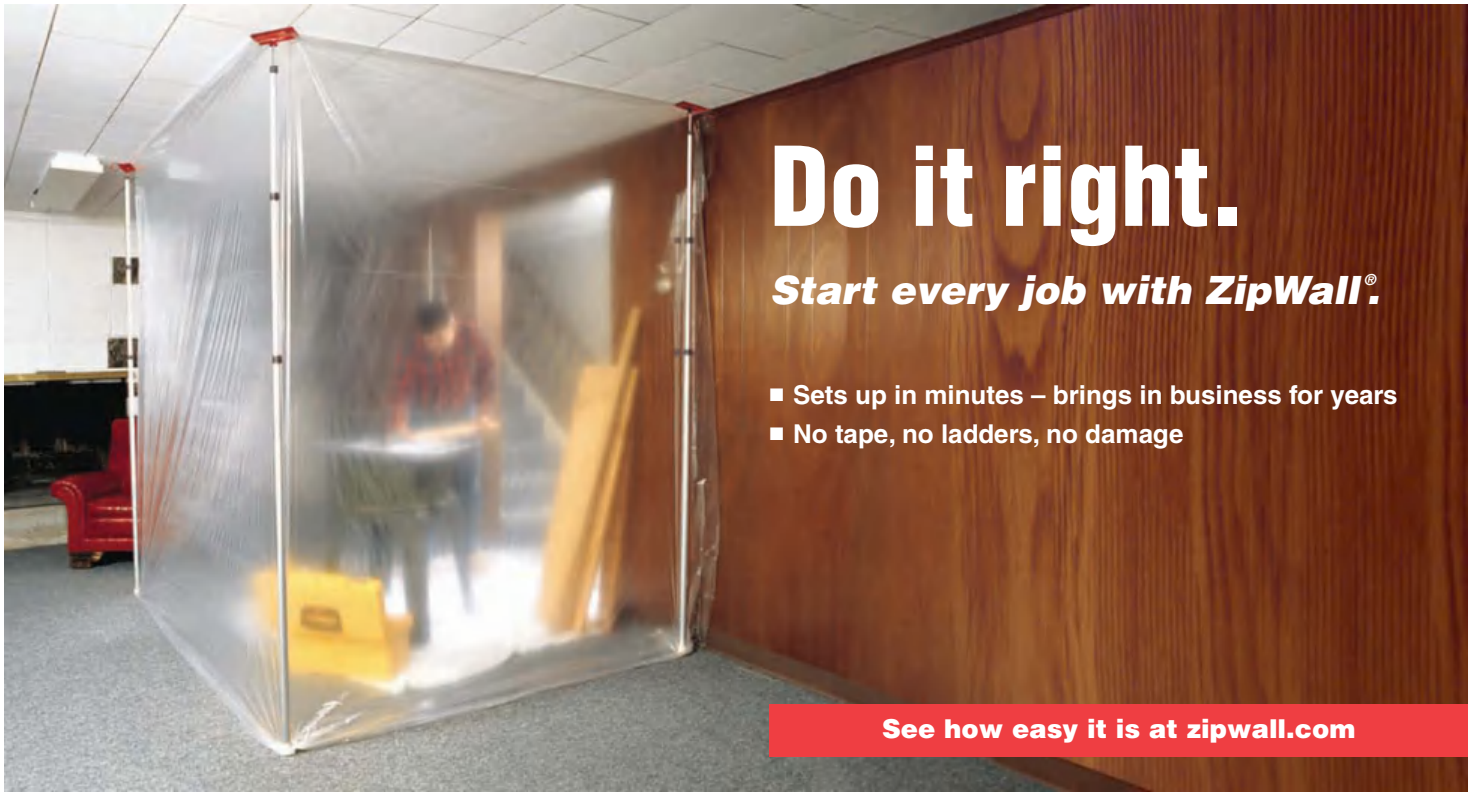


Flawless Two-Piece Baseboard

If you dial in your measurements and fine-tune your cuts, you won't need the painter to make your work look good

BY NICK SCHIFFER

In the world of building, finish carpentry is the second-to-last step before the homeowners move in—or in the case of a remodel like this one, before they reoccupy the room. My job is to make sure that the framers, drywall installers, and flooring guys who came before me look good, and that the painter who comes after me isn't left with the task of hiding sloppy joints, excessive nail holes, and oversize gaps.

Although many houses are trimmed with a one-piece, shaped baseboard that mimics the look of a traditional two-piece installation—a product known as speedbase—I still prefer the real deal: flat stock topped with a separate cap molding. This two-piece installation takes a bit longer, but it provides more leeway for finesse when it comes to hiding waves in walls and keeping joints tight at corners, even if they aren't square.

Clear the room and prep the area

My process for installing baseboard on remodel jobs is essentially the same as it is in new construction. The only notable exceptions are that remodels typically include a bit more job-site protection, may require

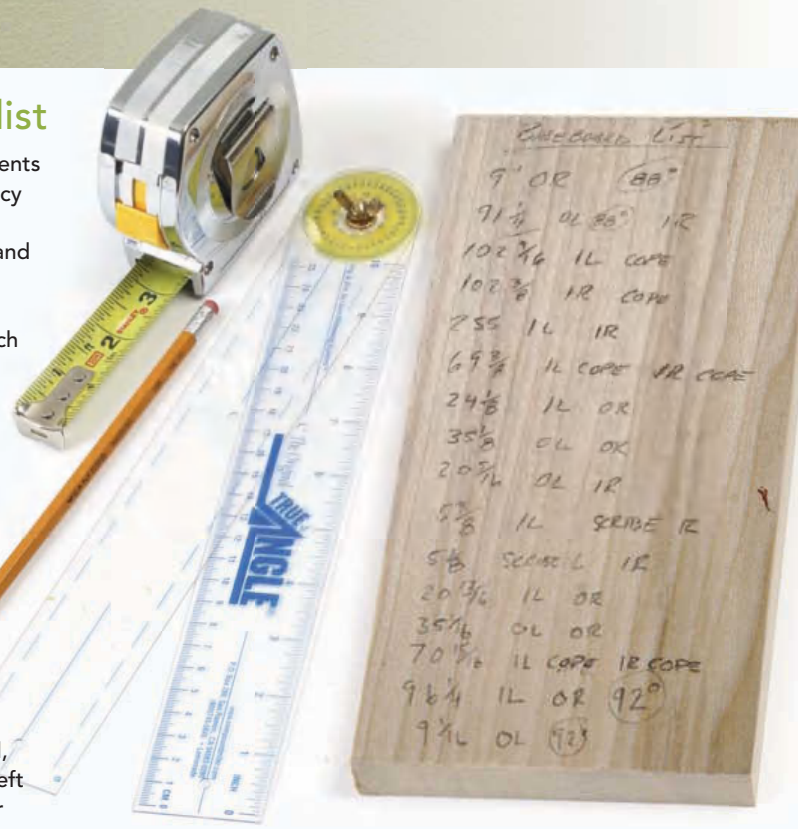
Continued on p. 37

Measure and make a cutlist

The installation starts with careful measurements and a detailed cutlist, which improves accuracy and reduces trips back and forth to the saw. For consistency, I always start at a doorway and work clockwise.

I make my cutlists with three columns. The first column is for length measurements, which I take along each wall at floor level. The next two columns are to indicate the type of cut needed on each end of every piece of stock.

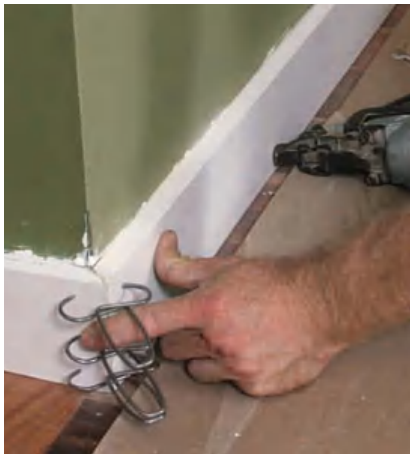
I check all inside and outside corners with an angle-finder—an indispensible $10 finish-carpentry tool—to determine if off-angle joints are necessary. I mark conventional inside and outside miters (90° angle) with the length and type of miter necessary on each end. *OR* indicates an outside miter on the right end of the piece of stock, *OL* indicates an outside miter on the left end, and *IR* and *IL* are for inside-right and inside-left miters. If I encounter an out-of-square corner (greater or less than 90°), then I write the adjusted angle that will be needed.



TWO-PIECE BASEBOARD FLAT STOCK

Cuts must be accurate

If you want to make efficient use of your accurate measurements, then your cuts have to be accurate, too. My measurements are of the actual walls, which means the lengths on my cutlist are from the long points of inside miters to the short points of outside miters. To remain accurate, I mark my stock the same way. On this piece, I cut the outside miter and measured along the face of the stock to mark the inside of the miter's short point. For inside corners, I typically miter the two pieces of flat stock together, setting the saw to make a 44.5° miter to ensure that the visible seam is tight.



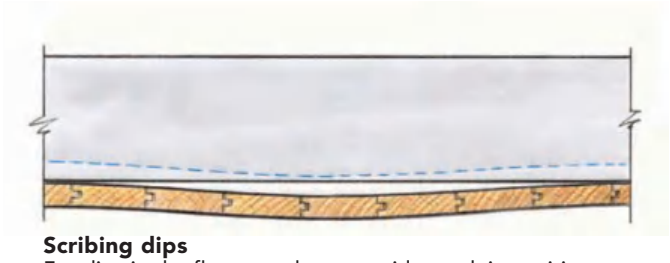
Keep flat-stock joints tight, flush, and tidy

My priorities when installing flat stock are making tight joints and getting a good fit between trim and flooring. This means scribing where necessary and sometimes adjusting the angle of a miter or marking a piece in place for a recut. Doing so yields tight joints that come together with no space or need for filler. I cut long pieces just a hair beyond the mark and then spring them into place. For outside corners, I focus first on the miter, holding nails back from the nearest studs until the miter has been glued and clamped. (I use Collins miter clamps.) Once the glue sets, I tack the corner to the studs and remove the clamps.

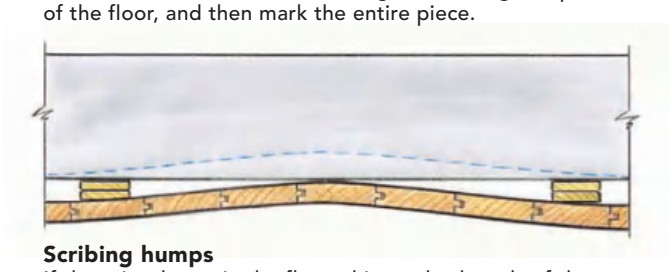
Drawings facing page: Dan Thornton

Scribing for a tailored fit

In minor cases, a pencil and a shim are all you need to trace the contours of the floor onto the piece of stock. From there, you can follow the scribed line, removing most of the waste on a tablesaw and fine-tuning the scribe with a jigsaw, a block plane, and/or a sander. Severe waves in the floor may require using wider flat stock so that the top edge of the baseboard remains at a constant height while the bottom edge follows the humps and dips in the floor.



Scribing dips
For dips in the floor, set the extrawide stock in position so that it spans the entire depression in the floor. Set your scribes to the desired finished height at the highest point of the floor, and then mark the entire piece.



Scribing humps
If there is a hump in the floor, shim up both ends of the baseboard to get it level, again setting scribes to the desired finished height.

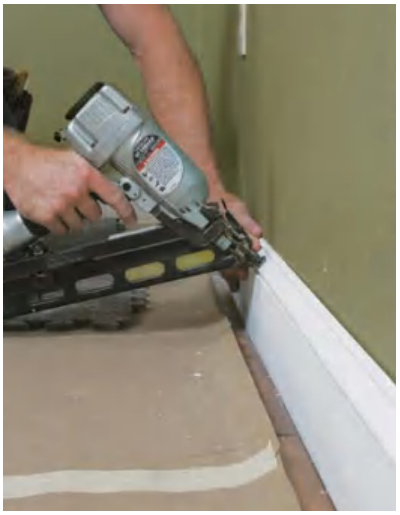
Reinforced splices

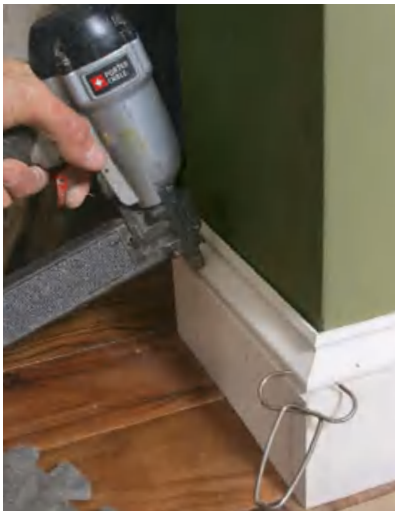
The traditional approach to making splices is to create a scarf joint (cutting the end of each piece on an angle), which ensures the largest glue surface possible. I prefer to handle splices with butt joints, though, which allows me to cut the trim pieces slightly long and spring them into place without worrying about one piece slipping past the other and creating an open joint. Normally a butt joint wouldn't be as strong as a scarf joint, because the end grain of wood doesn't glue together as strongly as the face grain, but I reinforce butt joints with a pair of tenons set into slots cut with a Festool Domino tool.

TWO-PIECE BASEBOARD CAP STOCK

The cap hides the flaws

The more flexible cap molding can conform to wavy walls and hide gaps behind the less flexible flat stock. But if the walls are severely wavy or have out-of-square corners, I switch to an 18-ga. brad nailer to fasten the cap molding to the flat stock below rather than into the wall. In these cases, caulk hides the gap between cap and wall.





Clean copes by hand

Because the cap is more visible than the flat stock it covers, inside corners are best handled by coping one piece of cap molding to fit against the other. This technique allows for slight deviations from square without tweaking the angle of the miter, and the seam will stay tight throughout the year, even if the cap expands or contracts with changes in seasonal humidity. There are many ways to cope a joint, but I learned to do it by hand. After cutting the piece to a 45° angle, I remove the waste with a coping saw held at a slight negative angle. I work my way from both sides of the end grain toward the center, then do a final cleanup with 180-grit sandpaper to leave a cleanly contoured profile.

Continued from p. 32

that I set up my saw outside or in a garage if the house is occupied, and likely involve removing the existing baseboard before installing the new.

Ideally, I remove all furniture and set up my miter saw and other tools right in the room that I'm working in. At the least, I move all the furniture to the center of the room and cover it with a drop cloth, then I find a nearby spot to set up shop for cutting.

I protect the floor of the room with kraft paper—holding it off the wall by a few inches so that it won't interfere with the baseboard—and seal doorways with plastic sheeting. With the room prepped, I remove any existing baseboard with a thin flat bar and a hammer.

Unless the baseboard is being saved, my priority is to keep the drywall intact. If the baseboard splits or breaks in half, I'm not concerned, but holes made in the wall that won't be covered by the new trim mean extra work. If the baseboard comes off in long lengths, I cut it into shorter sections on the miter saw so it can be loaded into a barrel alongside broken pieces and shorter remnants for carrying to the Dumpster.

To eliminate the chance of the new baseboard being hung up by old nails and debris, I pull any nails left behind in the wall, scrape away caulk, and vacuum the whole area. If walls are already painted, I mark stud locations with pieces of painter's tape or with pencil marks on the paper that covers the flooring. If the walls will be painted after my installation, I mark the studs just above where the new baseboard will go.

First comes the flat stock

For paint-grade jobs like this one, I use primed finger-jointed pine for the flat stock. Once I've cut pieces and positioned them on the floor where they will be installed, I look for places that will require excessive scribing along the bottom edge of the baseboard where it meets the floor. If the installation will be finished off with shoe molding, then scribing isn't usually necessary, but shoe molding isn't used much in my region.

All the flat stock is fastened with a pair of 2½-in.-long 15-ga. finish nails into each stud, and the mating mitered pieces of both inside and outside corners are coated with wood glue before being fitted together. I assemble most corners right in place, and I like to leave the first piece loose at least one stud back from the corner until the second piece has been fitted and clamped and the glue has dried. Small jogs and runs of trim with outside corners are often easier to fasten together on the workbench with glue and miter clamps and then to drop into place as one piece.

For long walls, it's necessary to splice together two pieces of stock with either a traditional scarf joint or a reinforced butt joint (see "Reinforced splices," p. 35).

Cap molding follows suit

The key to a quick cap-molding installation is to keep updating the cutlist as the flat stock is installed. If a piece of flat stock is cut to the measured length and ends up being a bit too long or an angle needs to be adjusted, I erase the original measurement on the cutlist and write in the updated measurement so that the cap molding can be cut right on the first try.

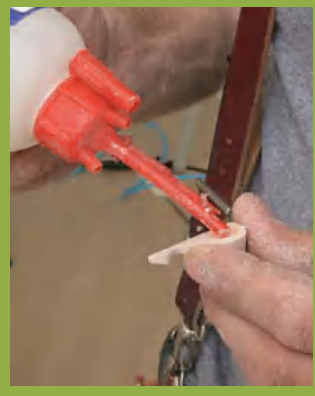
Unlike the miter joints on the inside corners of the flat stock, I prefer coped joints at inside corners of the cap stock, which ensures that the joints will fit tight through seasons of expansion and contraction. At this point, I map out which pieces will require a cope and on which end, adding that information to the cutlist as well.

In most cases, I fasten the cap tight to the wall using 2½-in. 15-ga. trim nails, always placing the nails in an area of the cap profile that will minimize hassle when the painter fills and sands the holes. The cap molding can follow the contours of the wall to a certain extent, concealing slight waves and gaps that the thicker, flat stock can't conform to, but I don't blindly follow contours of badly waved walls. If inside or outside corners are clearly out of whack or a long run has a big dip, floating the cap away from the wall is often less noticeable than trying to follow it snugly. In these cases, I switch to an 18-ga. brad nailer to fasten the cap molding to the flat stock below rather than into the wall studs, and then I fill the gap between cap and wall with caulk.

Most cap moldings are too small to be bored out easily with a Festool Domino tool, so rather than relying on butt joints and tenons for splices, I go with the traditional scarf joint. I cut the joint as steep as my miter saw allows to provide as much face grain as possible for the glue joint, but I avoid cutting these pieces overly long, as springing them into place often leads to a misaligned joint. □

Clean returns

Miter returns are a clean way to terminate the cap molding in situations where the end of the run of trim will be visible. These tiny returns are prone to splitting when nailed, so I assemble the pieces with fast-setting CA glue, such as 2P-10 (fastcap.com), and then install them as one unit.



Nick Schiffer is owner of NS Builders in Mansfield, Mass. Photos by Justin Fink.

Detailing Walls

Navigating the challenges of exterior insulation isn't the nightmare you might think it is

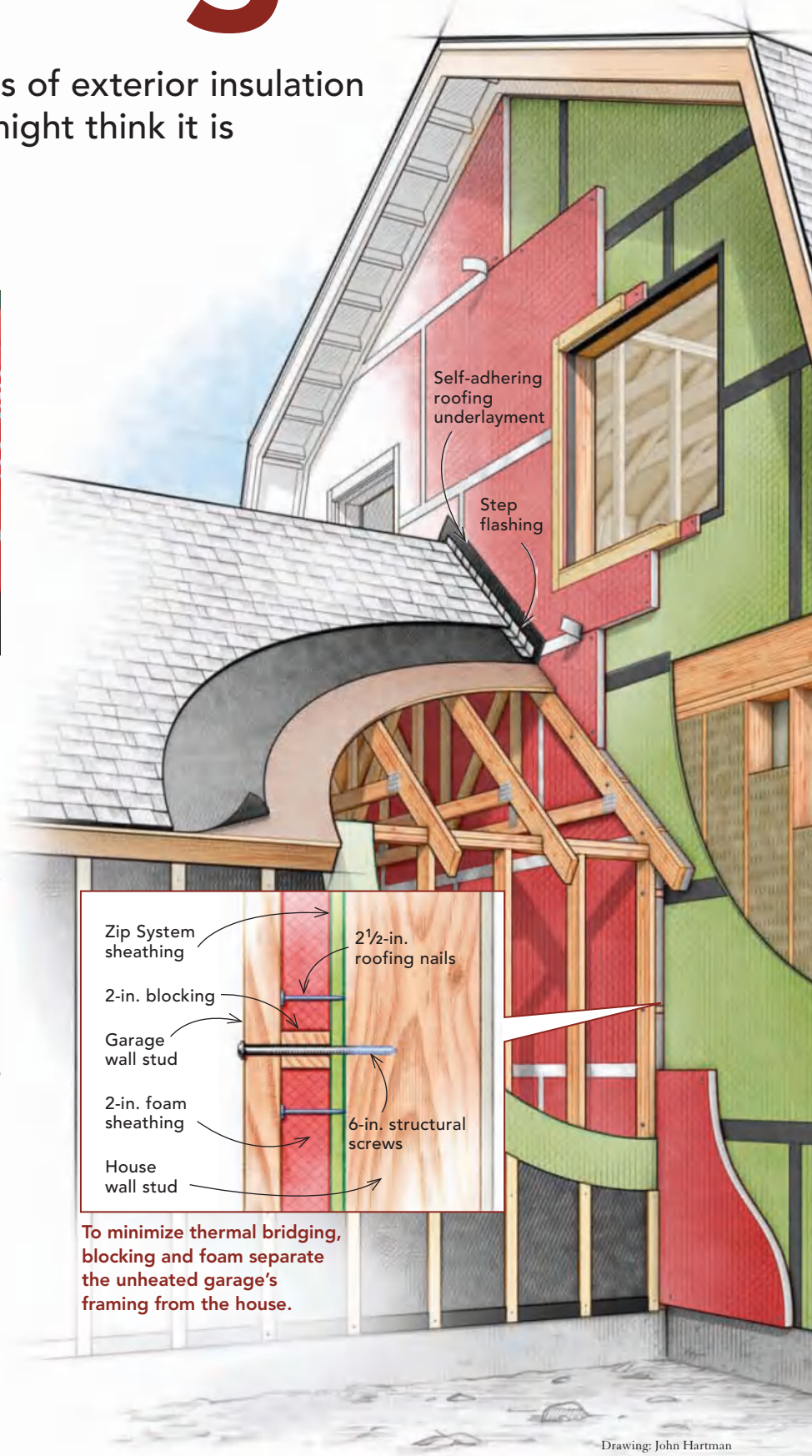
BY STEVE DEMETRICK

Wall construction has changed dramatically since I started in the trades 20 years ago. The 2x4 walls insulated with R-13 fiberglass batts that everyone built back then don't come close to complying with today's energy code in climate zone 5, where I live. And even with today's stricter codes, building just to code is like settling for a D in school. A house that only meets the minimum standard is the worst that can legally be built.

On this house, the combination of 2-in. foil-faced polyisocyanurate exterior foam and 6 in. of fiber insulation create a high-performance wall that exceeds the IRC requirements. But even meeting the minimum wall R-values required by the new energy code can be hard to achieve with cavity insulation alone. In climate zone 5, walls are required to be at least R-20, and standard batts yield R-19. In cold climates, exterior insulation in addition to the cavity insulation is becoming a de facto code requirement. But there are pitfalls, including moisture condensation, detailing challenges around windows and other penetrations, and the lack of a solid base for attaching the siding. Here's how I navigate them.

Walls that make sense

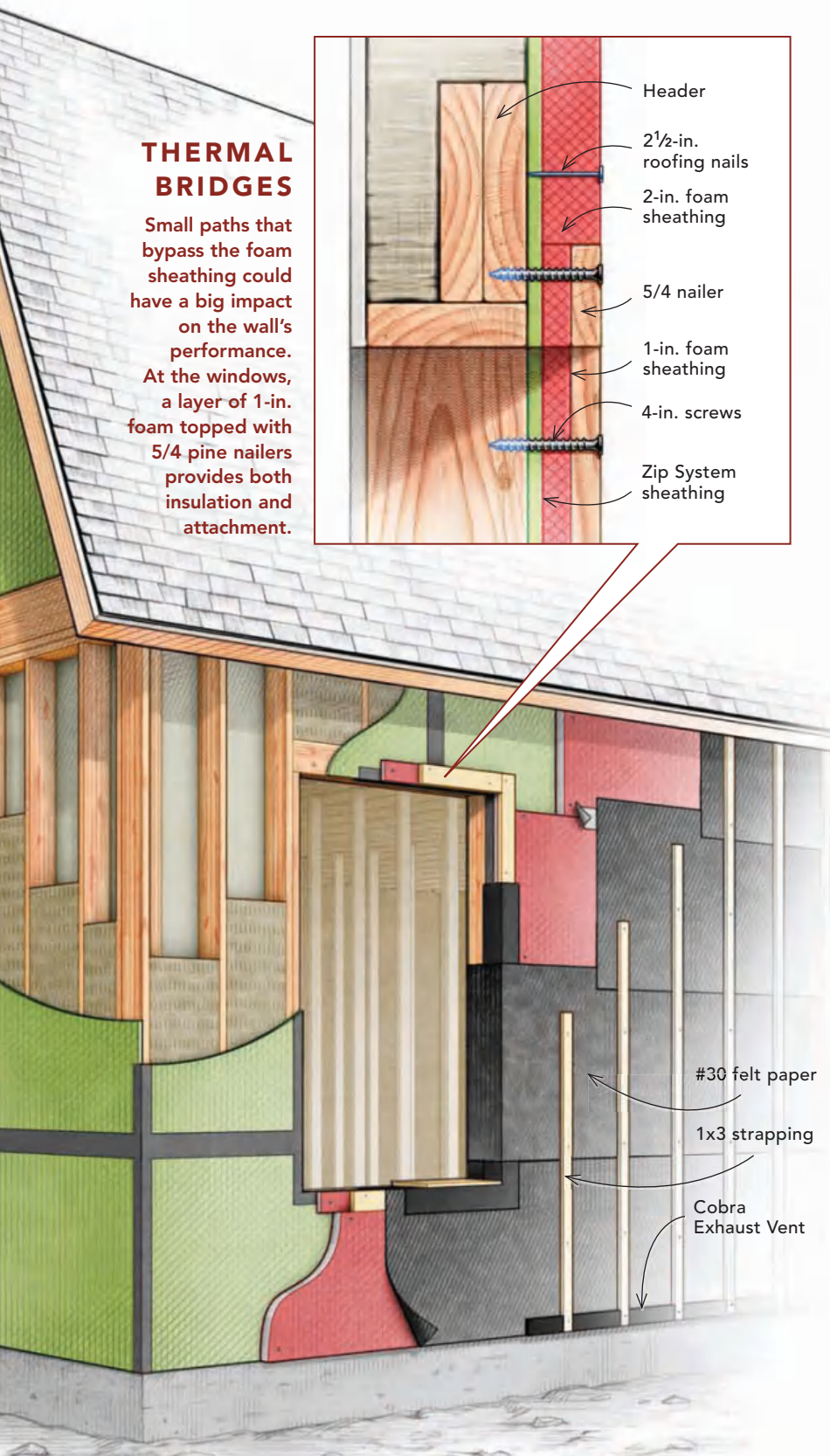
As a consultant on this build, I worked with carpenter Andrew Gallant of Gallant Builders on the wall details.



To minimize thermal bridging, blocking and foam separate the unheated garage's framing from the house.

Drawing: John Hartman

with Rigid Foam



Our combination of foil-faced foam and Zip System sheathing has created walls that are essentially impervious to moisture on the outside, meaning that they can only dry inward. To allow this, the wall cavities will be insulated later with unfaced fiberglass or mineral-wool batts, and the interior finish will be gypsum board, plaster, and vapor-permeable latex paint, all of which allow free movement of water vapor.

Because moisture generally moves from warm locations to cool ones, in this predominantly heating climate, the vapor drive is outward for most of the year. That makes controlling interior moisture a critical component of the house's system. Otherwise, water could condense on the back of the sheathing, causing rot. Accordingly, interior moisture will be managed by a combination of timed bath fans, kitchen exhaust fans, and an energy-recovery ventilator (ERV). Not too many years ago, the standard approach would have been to use an interior Class I vapor retarder such as polyethylene sheeting. Today we know that having vapor-impermeable surfaces on both sides of a wall traps any moisture that does sneak in, often leading to rot.

In addition to keeping out exterior moisture and air, being able to dry, and reducing thermal conductivity, walls also should be simple to build. A goal in all of my projects is to detail walls so that carpenters can build with familiar materials and tools. The walls shown here are a good example of that approach. The studs are 2x6s on 16-in. centers. The Zip System sheathing, with its seams carefully taped, doubles as the air barrier. Although the sheathing could also function as the house's water-resistive barrier (WRB), it was easier to detail the wall so that the WRB is just behind the siding.

Continuous foam significantly reduces thermal bridging through the studs and wall plates, increasing the total R-value of the wall. The assembly needs to be thought through before framing begins. The first step is to locate on the plans exactly where the foam-insulation plane is located and then identify any places where there are connections that might break the continuity of the foam.

Installing the foam

The 4x8 sheets of 2-in. polyisocyanurate are fastened to the wall sheathing with 2½-in. roofing nails. Only a few nails per sheet are needed because 1x3 strapping applied later provides the real holding power. There are many ways to cut the foam. My tool kit includes a Festool track saw, a Japanese pull saw, and a Tajima retractable knife whose long blade is handy for making quick cuts when

DETAILING ROUGH OPENINGS

Sheathing with foam is mostly dirt simple, with windows and doors being the trouble spots. The main things to keep in mind are providing solid nailing while avoiding creating a thermal bridge, and providing adequate flashing to keep out water.

Create a thermal break. *Nail foam strips 1 in. thick and 3½ in. wide around the opening.*

Install nailers. *Screw rough-pine 5/4x3 nailers over the 1-in. foam to build the assembly out to the plane of the main 2-in. foam insulation.*

Butt the wall foam to the build-out. *Installation of the rest of the insulation is simply a matter of cutting to fit and fastening with 2½-in. roofing nails.*

Add a solid sill. *To create a base for windows and doors, fasten a piece of ¾-in. sheathing to the bottom of the rough openings.*

Proceed normally. *With solid nailing established, installing windows or doors and integrating them with the WRB and the flashings is the same as on any other job.*

Photos facing page: Katelyn Gosselin

I'm not standing at the cut table. The foam seams are taped with 3-in. foil-faced tape.

Windows and doors are the biggest stumbling block with exterior foam. You need solid material at the surface to attach to. Building out to the plane of the foam with solid blocking would create a thermal bridge around every opening. Instead, Gallant nailed 3½-in.-wide rips of 1-in. foam around the windows, followed by 5/4x4 rough pine screwed to the framing through the foam, creating a thermally broken attachment point for the windows and doors. The 2-in. foam butts to this assembly. To create a solid base for supporting the windows and doors, Gallant screwed ¾-in. sheathing to the bottoms of the rough openings, which were built ¾ in. taller to accommodate the thickened sill. With this treatment, the window and door openings can be flashed just as on a typical wall.

Felt paper keeps out the rain

The most critical element of any wall assembly is the WRB and its flashings. On this project, the taped Zip System sheathing and the taped foam act as redundant WRBs, but the primary WRB is #30 felt paper and self-adhering flashings that go over the foam. From remodeling century-old oceanfront homes that stayed dry, I know that properly lapped and flashed felt paper works over the long term. I'm not so sure about WRBs that rely on the adhesion of tape to keep out water.

The felt paper is attached with 2½-in. roofing nails and is lapped shingle-style over all of the window and door flashing, as well as over the roof step flashing. To avoid having to hand-drive pounds and pounds of roofing nails to hold the felt paper if the wind kicked up, Gallant worked in small sections, installing the felt paper and following up immediately with strapping.

With very tight houses, it's important to seal the small holes made for items such as wires and pipes. On a Passive House I built, a first-floor window leaked significantly during a rainstorm through a 1-in.-long tear in the flashing tape. In a typical house, that wouldn't result in a pronounced leak, but this house was extremely airtight. The problem was located in the second-floor wall, where two 6-in. holes for the ERV intake and exhaust hadn't yet been connected. The wind depressurized the house through these holes. Because the house had so few leaks, enough negative pressure was created to suck water in.

With that in mind, wires for outside lights were taped to the sheathing prior to the installation of the foam. Once taped, wires were routed down the face of the wall a few inches and to the fixture or outlet to prevent water from following the wire into the wall. Larger holes for pipes or ventilation fans were first air-sealed at the sheathing with EPDM gaskets (foursevenfive.com) and then flashed to the foam with 3M's All Weather Flashing Tape.

The final step before installing the siding was to attach the 1x3 vertical strapping over the foam to provide nailing for the siding and trim. The strapping is fastened through the foam and the sheathing to the studs with 5-in. screws. The ¾-in. space formed by the strapping creates a generous drainage gap for water that gets behind the siding. The airspace also will ventilate the siding so it can dry evenly, resulting in a more durable installation and paint job. I know of similar houses that have gone 15 years without repainting. To keep vermin out of the space while allowing airflow, Gallant nailed Cobra Exhaust Vent between the strapping at the bottom of the wall. □

Steve DeMetrick is a builder and residential energy consultant in Wakefield, R.I. Photos by Andy Engel, except where noted.

There's more than one way to skin a house

Of the four common types of insulating sheathing, the foil-faced polyisocyanurate used here offers the highest R-value per inch (R-6.5). In addition, it's readily available and practically vapor impermeable (it's a Class I vapor retarder). Extruded polystyrene (XPS) is also readily available, is slightly vapor permeable (Class II), and offers an R-value of R-5 per in. Expanded polystyrene (EPS) may be a little harder to find, has an R-value of around R-4 per in., and is several times more vapor permeable than XPS (although it still falls within the Class II range). Finally, there is mineral-wool board, a denser material than mineral-wool batts. Mineral wool is open to vapor transmission and has an R-value of about R-4 per in.

Foil-faced polyisocyanurate
R-6.5 per inch

Extruded polystyrene
R-5 per inch

Expanded polystyrene
R-4 per inch

Mineral wool
R-4 per inch

Insulation ratio determines vapor-retarder type

When designing a wall, think about the risk of condensation within the wall cavity. The inside of the sheathing must be kept warmer than the dew point so that moisture doesn't condense there, so the ratio of exterior insulation R-value to cavity insulation R-value is critical. Either the exterior insulation needs to be sufficient to keep the sheathing above the dew point, or the cavity insulation needs to leak enough heat to achieve the same end. Colder climates require higher ratios and/or less permeable vapor retarders. To find the insulation ratio of a wall, divide the exterior R-value by the cavity R-value. In the chart at left, use the insulation ratio and the climate zone to determine whether a vapor retarder is needed, and if so, what class to use (e.g., Class II: kraft facing; Class III: latex paint).

Climate zone	Class II interior vapor retarder	Class III interior vapor retarder
1 to 3	No limit	
4	0.2	
5	0.2	0.35
6	0.25	0.5
7	0.35	0.7

Reinventing the

An architect uses the site itself to guide his take on a traditional style

BY ROB WHITTEN

Rimmed on the north by a mixed forest, the wide grassy field fell gently to the south, toward the road we'd taken to where we now stood. As a home site, the field in front of us promised the best solar gain you could ask for in this part of Maine, along with ample drainage, protection from north winds, and stunning views. It was a site that couldn't miss—whether you were a 19th-century farmer or a 21st-century architect.

I happen to be the latter. But when I laid out my plans for the site to Steve and Deb—the potential clients whom I had met that day in the field—I spoke as if I were that farmer. My firm would design their house on the slope toward the north, not the center, of that beautiful meadow. The tall side would face south, and the driveway would snake off into the trees to the northeast, because no self-respecting farmer would cut a road through the middle of a good field.

In a more timeless sense, what I was saying was that you don't place your house on the best land—you place it adjacent to the best land, to establish a relationship with it. This application of centuries of local wisdom appealed to Steve and Deb, and our conversation that day was just the beginning of

Farmhouse

SPECS

Bedrooms: 3
Bathrooms: 2½
Size: 2500 sq. ft.
Cost: $275 per sq. ft.
Completed: 2013
Location: Freeport, Maine
Architect: Whitten Architects, Portland, Maine; whittenarchitects.com
Builder: Rousseau Builders, rousseaubuilders.com
Interior designer: Krista Stokes, kristastokes.com

A farmhouse evolves

From the right site ...

It's typical today to plop a home directly in the center of a site, but a more traditional—and wiser—approach is to consider solar orientation, wind direction, drainage, and the desirability of preserving the best land (for farming in the past, for the view in the present). Those factors led the author to position this contemporary farmhouse in the far northeast corner of the site, near the top of a rise. While the house faces south toward the sun, the barnlike garage is angled to allow the driveway to curve off into the trees at the edge of the site, preserving the meadow and the view.

On higher ground. *Positioning the house on an elevated corner of the property preserved the character of the large parcel of land and enhanced the owners' southern views over the undulating terrain.*

a dialogue about how best to incorporate that knowledge into the building of their comfortable, durable, and contemporary farmhouse.

Downsizing done right

When they first decided to downsize, Steve and Deb considered buying an old house. But then a piece of land they had admired for years came on the market. They started assembling a virtual catalog of what they liked and didn't like in a house, and they reached out to a few local design-build firms and a few architects, myself included.

In true Yankee tradition, Steve and Deb were looking for straightforward answers and good value in the design of their new home. The traditional approach I described that morning appealed to them, so with a clear understanding of their budget and their design goals, I got the job. As the design developed, I was joined by Whitten Architects team member Will Fellis, who comes from a long line of Maine builders and has both an innate and a trained understanding of local building traditions.

The second step I always take before designing a new home is to visit the clients' current house. This accomplishes two things. First, it reveals why the first house doesn't work. Second, it enables me to design spaces that will accommodate the clients' furniture and lifestyle. My visit revealed why Steve and Deb had struggled with their last

Drawing this page: Toby Welles, WowHouse

From yard to door. *The so-called dooryard area that stretches from the front of the barn toward the house is the starting point for arrival and influences the position of the mudroom, the back entry, and the kitchen.*

house. Although 2900 sq. ft., it was poorly organized, so much of the space was unused. Steve and Deb were clear that they wanted a house of no more than 2500 sq. ft., with a first-floor master, a hardworking mudroom, and a home office that would be, in Sarah Susanka's language, an "away space." They wanted this to be their lifetime house.

From site to spaces

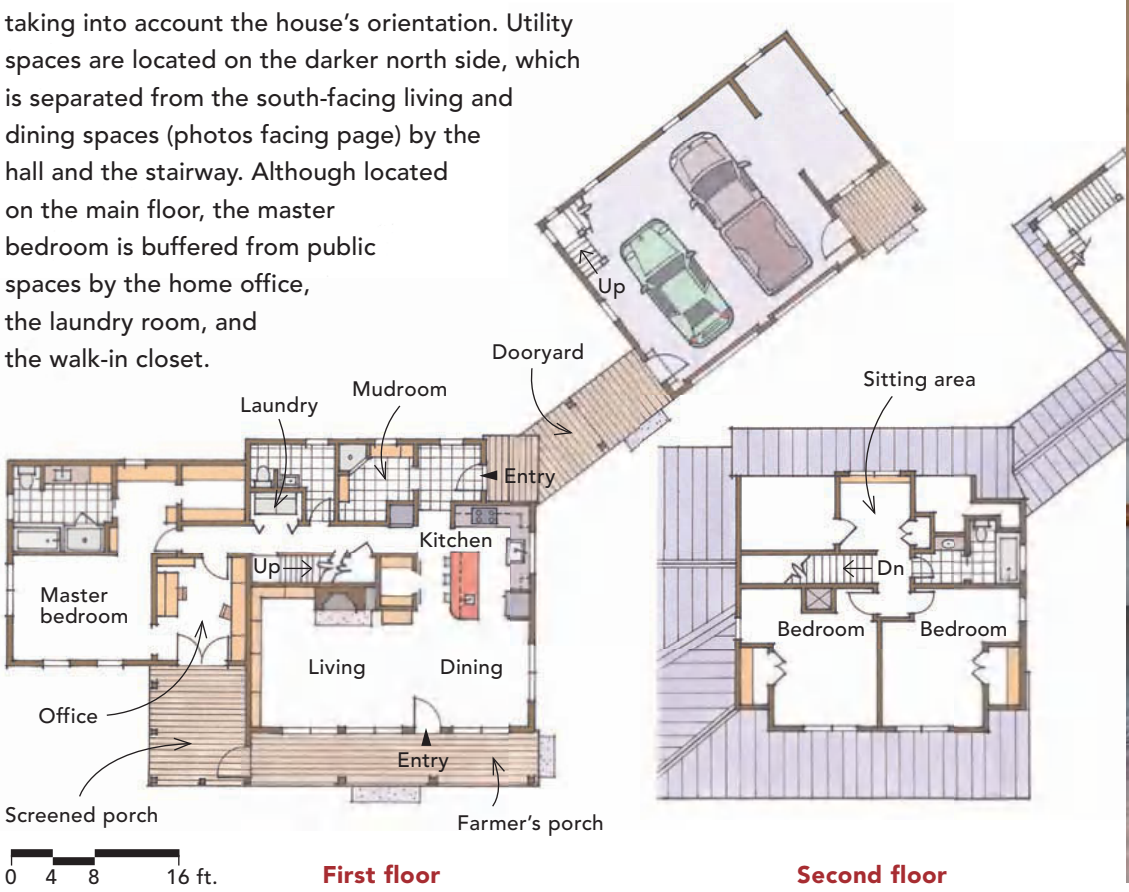
When I design a house, I start with the site plan. I use that to develop the floor plan, which in turn shapes the house's overall form. In a sense, this follows the tradition of New England farmhouses, which are essentially simple, efficient boxes encasing a floor plan suited to

… to the arrival sequence …

How one approaches the house—from the driveway, into the dooryard, and then inside—informs the organization of doors, service areas, and ultimately, the floor plan. A farmhouse is an informal country home; to enter and exit, everyone uses the back door and the mudroom entry. The front door is used to access the front porch and is placed in the ceremonial, front-and-center location.

… to the floor plans …

The arrival sequence continues inside the house, determining the layout of the first floor and then the second while also taking into account the house's orientation. Utility spaces are located on the darker north side, which is separated from the south-facing living and dining spaces (photos facing page) by the hall and the stairway. Although located on the main floor, the master bedroom is buffered from public spaces by the home office, the laundry room, and the walk-in closet.



their site. In choosing that site, 19th-century builders thought first about the sun, then about the wind, and then about proper drainage. Their time and effort were not put into making a palace, but a house that worked with the land.

In those days, building on a slope was favored because it meant less digging, which was done by hand. We took a similar approach, tucking the house into the land in a traditional manner. Building this way also allows runoff to drain away from the foundation—in this case, aided by a perimeter-drain system we installed uphill from the house.

Like those old farmers, our goal was a house of modest scale. The modern-day challenge, however, is that once you attach a garage, you end up with a huge appendage that represents almost a third of your footprint. The answer is to move the two apart. In Maine, a sheltered outdoor space between the house and garage or barn where you do your work is referred to as a *dooryard*. There is a tradition in Maine of dooryard visits, in which neighbors pull up to the house and roll down the window to chat with whoever is working there.

Following this arrival sequence—from the car, to the mudroom, to the service spaces, to living and dining areas, and finally, to more private spaces—enables the floor plan to evolve naturally. To make the most of 2500 sq. ft., we turned to an open plan in which public spaces were shared. I always begin by laying out the first floor, which tells me where the stair wants to be, which in turn brings me to the second floor. I want the second-floor bedrooms to be facing the sun, so they fall into place next. I also like the bedrooms to have windows on two walls for ample light and cross ventilation.

A form unfolds

With the interior spaces in place, the form of the house begins to reveal itself. It is shaped by the rooms inside and by the character of the area. Steve and Deb's home site is located just outside the village of Freeport. The area is full of smaller-scale houses built from the 1780s to 1900, offering a traditional frame of reference.

Because this house was situated outside the village, I believed that a farmhouse form would be most appropriate. We were drawn to the Cape style, with a raised dormer facing the sun and an unbroken roof slanted against the north winds. To me, this represented a type of small and simple house with the economical patterns we wanted. I used pitches of 11-in-12 on the main roof and a gentler 5-in-12 on the roofs of the porch, the breezeway, and the dormer. The pitch of the master wing falls between them at 8-in-12 and is offset 2 ft. from the north wall of the house. It adds character and scale, and it suggests that the master wing was a later addition by the "farmer."

Now it was time to think about windows. We confined our windows to four types, the most prominent being two-over-one double hungs and four-lite casements. Each of the upper lites matches the

Floor-plan drawings: Martha Garstang Hill

Arriving at home. *The mudroom entrance, used by family and friends alike, leads into the kitchen, which is also positioned with a view toward the driveway.*

Traditional touch. *In the living room, the modified Rumford fireplace is taller and more efficient than a typical fireplace. The built-in firewood box offers a historic reference to a traditional New England beehive oven, but with more functionality.*

Smooth landing. *At the top of the stairs, a small landing becomes a private space for guests, who also use the upstairs bedrooms.*

proportion of the window overall, creating a harmony to the way the pieces come together that's both spare and refined at the same time.

With windows and doors in place, we moved outside to add the transitional spaces—porches, patios, and shelters—that complete the connection between what's inside and what's outside. Those include a covered walkway to protect the route from the garage to the mudroom, and a 6-ft.-wide farmer's porch to shelter the front door and to provide protected, outdoor living space. Beyond the porch, we planned a fieldstone wall to enclose a stone terrace and fire pit.

Steve and Deb already had stretched their budget, so we wanted to keep the exterior simple. Steve and Deb also valued low maintenance, so we invested in a standing-seam Galvalume roof, prefinished Maibec white-cedar shingles (installed over a drainage gap), and prefinished board-and-batten siding for the garage. Trim and corner details are thin and Shaker-like, which helped keep material costs in check.

High performance, then and now

Built to relate to the land, sun, and climate, a traditional farmhouse was the high-performance, low-cost house of its day. We used those wonderful vernacular lessons because they work, but we also included some more recent technologies to boost this house's efficiency.

We used Zip System sheathing over 2x6 walls insulated with 4 in. of closed-cell spray foam (R-30); rafter bays under the Zip-sheathed roof are insulated to R-49 with 8 in. of closed-cell spray foam. (Closed-cell

Drawings facing page: courtesy of Rob Whitten

… to the final form

Once the interior spaces are organized, transitional spaces linking them with the outdoors can be established. Those include a wide farmer's porch, a screened porch off the home office, a terrace and fire pit just off the farmer's porch, and a covered walkway connecting the house to the garage.

Covered connection. *A sheltered walkway links the house's back entrance with the garage, about 20 ft. away. LVLs held up by tapered columns support the roof.*

foam is derived from petrochemicals, but we decided that its ability to lower the home's energy demand balanced out the environmental penalty involved in its manufacture.) The outside of the foundation and the underside of the basement slab are insulated with 2 in. of rigid foam (R-10). Our last blower-door test put airtightness at 0.36 ACH50, thanks to carefully detailed wall and roof assemblies, taped sheathing, spray foam, and a meticulous framing crew. Tight houses need a source of fresh air, so Steve chose a heat-recovery ventilation system that exhausts from the bathroom and kitchen area, with supplies to the first-floor bedroom and living spaces.

Harboring a Yankee bias against overdependence on someone else, Steve settled on a closed-loop geothermal heating system utilizing a Bosch two-stage ground-source heat pump and a desuperheater with electric backup for domestic hot water. We also built a chase through the house that will enable Steve and Deb to install photovoltaics on the master-suite roof when their budget allows.

As the house neared completion, we received emails and comments from neighbors and passersby telling us how much they loved the way it looked in the field. It was gratifying to know that we were being seen not only as good neighbors but as responsible stewards of a very special piece of land. □

Rob Whitten founded Whitten Architects in 1986. Photos by Rob Karosis.

Guide to Gas Fireplaces

BY JAMES CLELAND

Gas fireplaces and stoves are easily the most popular segment of the home-hearth industry, outselling wood-burning models nearly three to one. Convenience is the driving force behind the popularity of gas. There's no cordwood to haul, store, and stack. There's no ash to clean up, and no smoke smell filling the house. Instead, there's a steady supply of fuel piped directly to the unit. When you want a fire, you can have one up and running with the push of a button, often without getting up from your seat. When it's time for bed, you can shut down the fire just as easily.

Although it's simple to use a gas fireplace, it's not so simple to install one. Further complicating matters, there are three basic types, and the design options are nearly limitless. To keep up with Houston's booming housing market, the company I work for installs dozens of fireplaces every week.

Here, I share what I've learned about choosing among the three basic gas-fireplace types. I also explain what it takes to install and maintain a gas fireplace and identify the features and accessories you should consider when planning a purchase.

Gas is a different experience

Although gas fireplaces are convenient, wood purists often counter that splitting and storing firewood is great exercise and that having a good supply of wood means a reliable source of heat in all conditions without the risk of a disrupted fuel supply. In addition, those who like building and tending fires likely will be disappointed by the experience of a gas fire. The flames are less varied, the color is uniform compared to a wood fire,

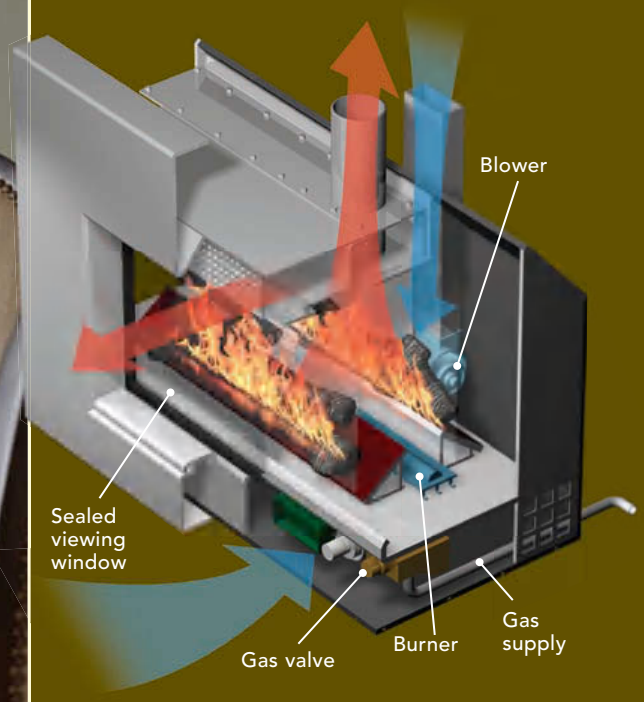
An industry veteran explains how to get

Photo: courtesy of Mendota (Fullview 44i). Drawings: Don Foley.

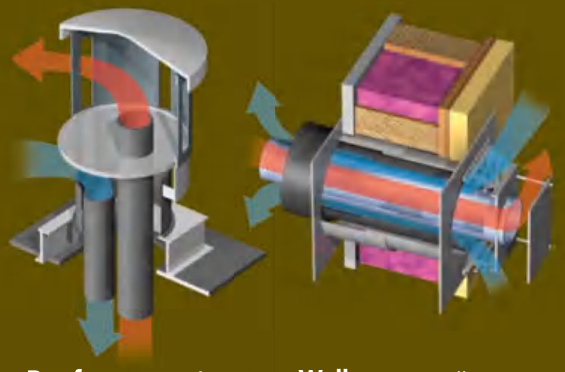
the right gas fireplace for your home

HOW IT WORKS

The gas supply comes into the bottom of the fireplace housing, where it connects to the main gas valve. Older models had a fuel-wasting standing pilot, but modern fireplaces have an electronic ignitor that lights the pilot, which in turn lights the burner. Once the pilot is lit, the gas valve opens and the burner ignites. Many units have a remote control to change flame height and Btu output by opening or closing the gas valve. Near the gas valve is a battery compartment and a manual ignition system, which makes it possible to use the fireplace in power outages.



Two ways to vent



Roof cap A roof-vent termination looks a lot like a chimney cap for a wood-burning fireplace, but it has two pipes inside: one for combustion by-products and a second for combustion air.

Wall cap A wall-vent termination typically makes installation easier, but it gets hot when the stove is operating, which can create a risk of burns when the termination is close to outdoor walkways or seating areas.

A FIRE FOR ALL PLACES

Traditional Freestanding gas stoves such as the Tiara from Heat & Glo provide a traditional look with modern convenience. Available in several finishes, this cast-iron stove vents through the top for a classic woodstove look. Stoves and fireplaces also can be vented through the rear, which is often an easier installation method.

Modern Gas fireplaces used to look just like their wood-burning counterparts, but new designs take many forms. The Flatfire from Wittus, for example, has a long narrow firebox fit for modern spaces. There are also sophisticated remote controls that enable you to change the flame height and output, set a timer, and control built-in lighting.

Outdoor Gas fireplaces are becoming more common in outdoor rooms and entertainment areas, where they provide a natural gathering spot and can take the chill off during a cool evening. The 42-in. Heatilator Dakota is made from stainless steel for corrosion resistance.

Photos: courtesy of the manufacturers

and there's no opportunity to move logs around with a poker.

But even though they don't crackle or produce that sweet smell of smoke, gas fireplaces continue to look more realistic every year. Manufacturers use real firewood to make the molds for casting the log sets, and then they often hand paint them, further adding to their realistic look. My favorite recent innovation is LED lighting in the bottom of the firebox that simulates the look of glowing coals.

Sizing and installation

Excluding custom commercial models, gas fireplaces are sized from about 10,000 to about 50,000 Btu of heat per hour. The size of the unit should be based on the size of the space where it's located, not the whole house. Unfortunately, many buyers have a "bigger is better" mentality, which can lead to an oversize fireplace that drives folks out of the room. Besides heat output, the physical dimensions of the fireplace should be considered, as a fireplace that's too big or too small looks out of place even to casual observers. Manufacturers have sizing charts and online calculators that take into account the size of the room and the size of the wall.

Installing a gas fireplace is often more complicated than installing a wood fireplace. A manufactured wood fireplace is typically installed by the fireplace dealer without additional subcontractors, but a gas fireplace requires an electrician to run the cable that powers lights and the ignition system, as well as a plumber to run the gas or propane line to the unit. Coordinating the subtrades is the builder's responsibility for new-home installations. In retrofits, this subcontracted work can be handled by the fireplace dealer, the homeowner, or a general contractor.

Venting

Perhaps one of gas's best attributes is that venting options are greater than with wood. With a wood-burning fireplace, you pretty much have to go straight up through the roof or straight up the outside of an exterior wall with insulated flue pipe, which can be expensive and, depending on the floor plan, may not be possible at all. Masonry chimneys are even more costly and inflexible when it comes to venting.

The first option for venting a gas fireplace is to choose one that doesn't require venting in the first place. While this may seem like an easy installation, my company advises clients to steer clear of unvented fireplaces for a number of reasons (see "Is 'vent free' a good idea?" right). Next, there are models that use standard B-vent flue pipe and are vented atmospherically through the roof like a gas furnace or water heater. Generally speaking, you can use two elbows for snaking around obstacles, and you need to maintain manufacturer-specified rise-to-run ratios so that the appliance drafts correctly. Finally, there are direct-vent fireplaces, which have the most-flexible venting options. Direct-vent models send their combustion by-products directly through a wall or roof using two-chamber pipe that also acts as a combustion-air intake. Even though the flue pipe used with a direct-vent gas fireplace costs more than B-vent flue pipe, the total installed cost is often less, because a more direct route to the exterior of the building often means using less pipe. Direct-vent flue pipe also can be run horizontally in joist cavities, and some direct-vent models can accommodate up to four 90° elbows in their flues. For especially long and complicated runs, a power vent fan can be added to the vent system to improve draft. This fan can be placed either at the vent termination or at an accessible spot along the vent pipe. With any gas fireplace, it's critical to follow the manufacturer's installation instructions exactly. The instructions explain proximity to combustible materials and how close vent terminations can be to windows and doors, overhangs, porches, and walkways.

Useful features

The heat from a gas fireplace is mostly radiant, so it works best when you're directly in front of it. If you're hoping to heat a larger space more efficiently, consider a model with an electric blower, which is an option on many models. I think it's also a good idea to opt for a gas fireplace with adjustable flames so that you can control the amount of heat being produced. This is especially important in my area, where it's seldom cold enough for a raging fire.

The biggest innovations in gas fireplaces in recent years have come in the form of increasingly sophisticated remote controls. Multifunction remotes can control flame height, built-in lighting, and circulation blowers. They also can be programmed to a specific thermostat setting—automatically adjusting the burner as needed—and can be set to shut off the fire after a predetermined amount of time, much like the sleep timer on your television. A new batch of electronic controls are expected to work with smartphones and tablets.

Maintenance

Modern gas fireplaces are durable and long lasting, and we see few problems related to product failure. When we do get a service call, the problem is usually a result of improper maintenance.

Unlike the superefficient blue flame of a cookstove, fireplaces have a fuel-rich yellow flame (meant to replicate a wood fire) that produces more soot than a blue flame. As a result, every year the burners and ignition system should be cleaned by a manufacturer-certified technician. □

James Cleland is service coordinator at Perfection Wholesale Supply in Houston.

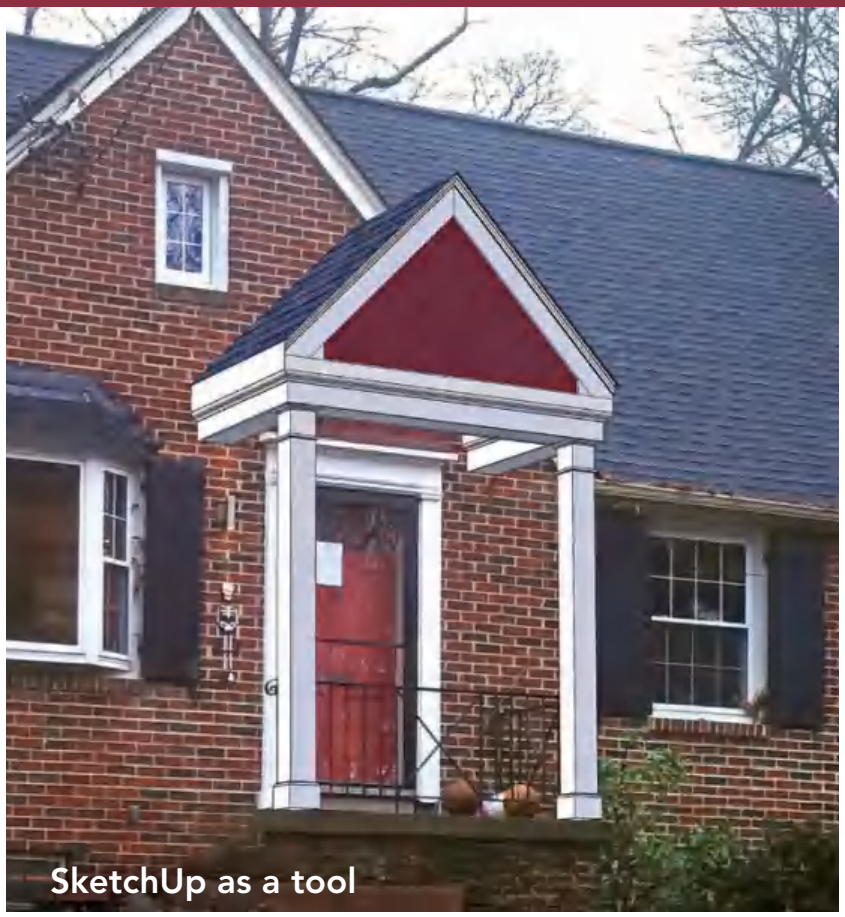
Is "vent free" a good idea?

At first glance, there's something very appealing about a vent-free gas fireplace. Not having a flue saves money on the installation and allows you to put the fireplace virtually anywhere. Unfortunately, the fireplace's combustion by-products aren't magically treated. Instead, the gases, which include carbon monoxide (CO), are released into the room. CO in sufficient concentration can cause fatigue, dizziness, and even death. To make these fireplaces safer, manufacturers include a sensor that shuts off the appliance if the oxygen level drops to an unsafe level. Running a gas appliance without a flue also puts a lot of water vapor into the air. At a minimum, this water vapor can lead to condensation on windows and doors that obscures the view and can rot or discolor sashes and sills. Excess indoor humidity can also aggravate allergies because it causes dust mites and mold to flourish. With today's tighter houses, I believe there's no place for unvented gas appliances, fireplaces included.

The Precut

The job

It was clear that the existing facade, while nice enough, would benefit both visually and functionally from an entry portico.



SketchUp as a tool

A computer model of the architect's plan was superimposed over a photo to show the homeowner what the final portico would look like.

BY MICHAEL PATTERSON

Make it look like the pretty picture. That's our job as carpenters—to bring someone's ideas to life in three dimensions. Sometimes, though, the carpenter and the customer have different visions, and details get lost in the translation. Avoiding that issue is one reason we have drawings.

There's another reason as well. Good drawings help me to complete the work quickly. A recent project where I built a portico on top of an existing concrete-and-brick stoop provides a good example of how drawings speed my work. Efficiency starts with thinking the details through beforehand. That sounds pretty obvious, if only because every job needs a materials list, a plan for how to proceed, and a time estimate. But in cases such as this small portico, I expand the concept. In the past, I would have estimated the rough dimensions of the parts and pieces to order the material. Once on site, I'd have figured out the exact dimensions of the framing, cutting the pieces to size just before installing them. Next, I'd have measured the installed framing to determine the sizes of the trim pieces, spending a lot of time running up and down a ladder. Complicating matters would be doing all that outside.

A few years ago, I started tackling smaller projects by first developing a detailed drawing and a cutlist with the exact dimensions of nearly every piece in the project. From that detailed list, I cut as much of the project as possible in my shop, right down to the trim. I usually still have to cut a piece or two on-site when existing conditions vary enough to make precutting dicey. Even on those pieces, though, I still do as much dimensioning or shaping as possible in the shop.

The advantages are obvious. The cutting is done with shop tools, which tend to be more

Photo far right, facing page: Greg Hadley

Porch

A detailed SketchUp model and cutlist allow much of this portico's prep work to be done in the shop

Most components were cut, and some were assembled, in the author's shop. Site time was reduced, benefiting both carpenter and client.

The completed portico deviates from the computer model only in the railing and the door treatment, the result of decisions made later in the process.

accurate than job-site tools. Much of the work is done out of the elements, and because the on-site time is minimized, there is less disruption to the client's life. My shop is at my home, so I have no commute, which is nothing to sneeze at in the traffic-clogged Washington, D.C., area. I also find that I can complete the job more quickly, in part because my trips up the ladder are only to install the components, not to measure for them.

Measure, then draw in detail

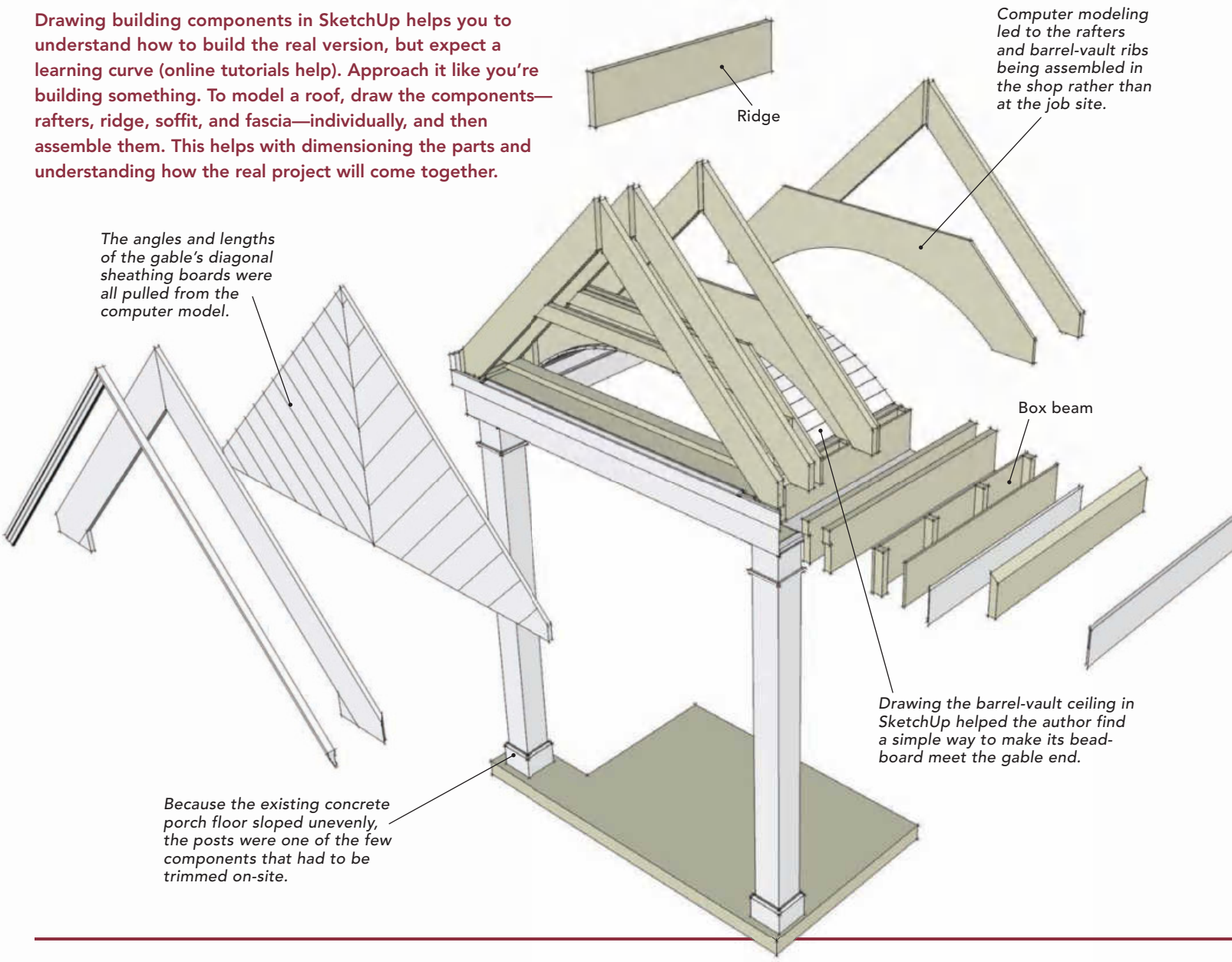
This portico was designed by Amy Stacy, an architect with whom I work regularly. Her drawings were accurate enough for me to estimate from, but to build a computer model and a cutlist with dimensions that were guaranteed to fit, I needed to quantify the site conditions exactly.

Conditions I check include not only dimensions but such things as whether the existing construction is plumb and level. A house wall that leans out far enough could, if not accounted for, leave the new column bases overhanging the edge of the stoop. I did find that this stoop wasn't level, so the posts had to be trimmed on-site. Since the new portico roof had to tuck just beneath and run parallel to the rake board on the existing roof, I verified that the roof pitch was drawn correctly on the plans. I also checked to see if the concrete stoop was centered on the door, or if it was offset. This would affect where the columns could be located.

One aspect I didn't check came back to bite me. I assumed that the house's brick walls were structural, a common detail in this neighborhood that would mean I could cut pockets into the brick and support the insides of the roof beams on the house wall. However, they turned out to be brick veneer, which by code can't be used structurally to support a load. This meant that I had to add structural posts down the face of the wall. Because of how these posts ended up having

"BUILD" IT ON THE COMPUTER FIRST

Drawing building components in SketchUp helps you to understand how to build the real version, but expect a learning curve (online tutorials help). Approach it like you're building something. To model a roof, draw the components—rafters, ridge, soffit, and fascia—individually, and then assemble them. This helps with dimensioning the parts and understanding how the real project will come together.



to be spaced, I had to move a light, which led me to add the paneling around the door. This is a good reminder to make no assumptions and to check everything carefully.

You can draw the parts of the structure underlying that pretty picture a number of different ways. In the past, I often drew things out full scale on a piece of plywood using a construction calculator and a framing square. Then I discovered a free drawing program called SketchUp. While it is not as powerful as a traditional CAD program or design-specific software programs such as Chief Architect or Revit Architecture, it lets me draw on the computer like I had so often drawn on plywood.

To develop the cutlist for this portico, I began by looking at the finished dimensions on the architect's plans. Then thinking from the outside in, I built a model of the portico in SketchUp with exact board-by-board dimensions. First came the trim, whose outside dimensions sprang from the architect's plans, and then the framing members, whose size was determined by the trim's dimensions. Math doesn't lie. Assuming you have accurate measurements, if it fits together on-screen, it will fit on-site. The computer model's dimensions became my cutlist.

Working things out on-screen allowed me to explore the easiest way to build certain details. For example, it became obvious that the barrel-vaulted ceiling would be easier to build if I assembled its arched ribs and straight rafters into trusses in my shop, to be set as units on-site. Another example was a fiber-cement panel on the inside gable face that had to meet the curve of the barrel vault. I wondered how I'd make that curved cut, but when doing the SketchUp drawing, I realized that instead of the difficult task of cutting the fiber-cement panel to fit the ceiling boards, I could frame the roof so that the panel dropped in from above. Then I could butt the ceiling boards to the panel—a simpler, faster, and cleaner approach. Small details like that add up to a real time savings and a better-executed project.

1 Build in the shop

Pocket screws from the back create a hidden connection between the rake boards and the cornice returns. It's a sturdy joint that looks good and can survive transportation to the site.

2 Load on the truck

All the components of the portico fit in one truckload for delivery to the site. Sitting on top are the roof trusses.

3 Assemble at the job site

After the posts were trimmed, erected, and braced, the lightweight box beams were lifted easily into place. Layered on top of the framing, the precut trim was nailed into place quickly and easily.

Make the parts like the drawing

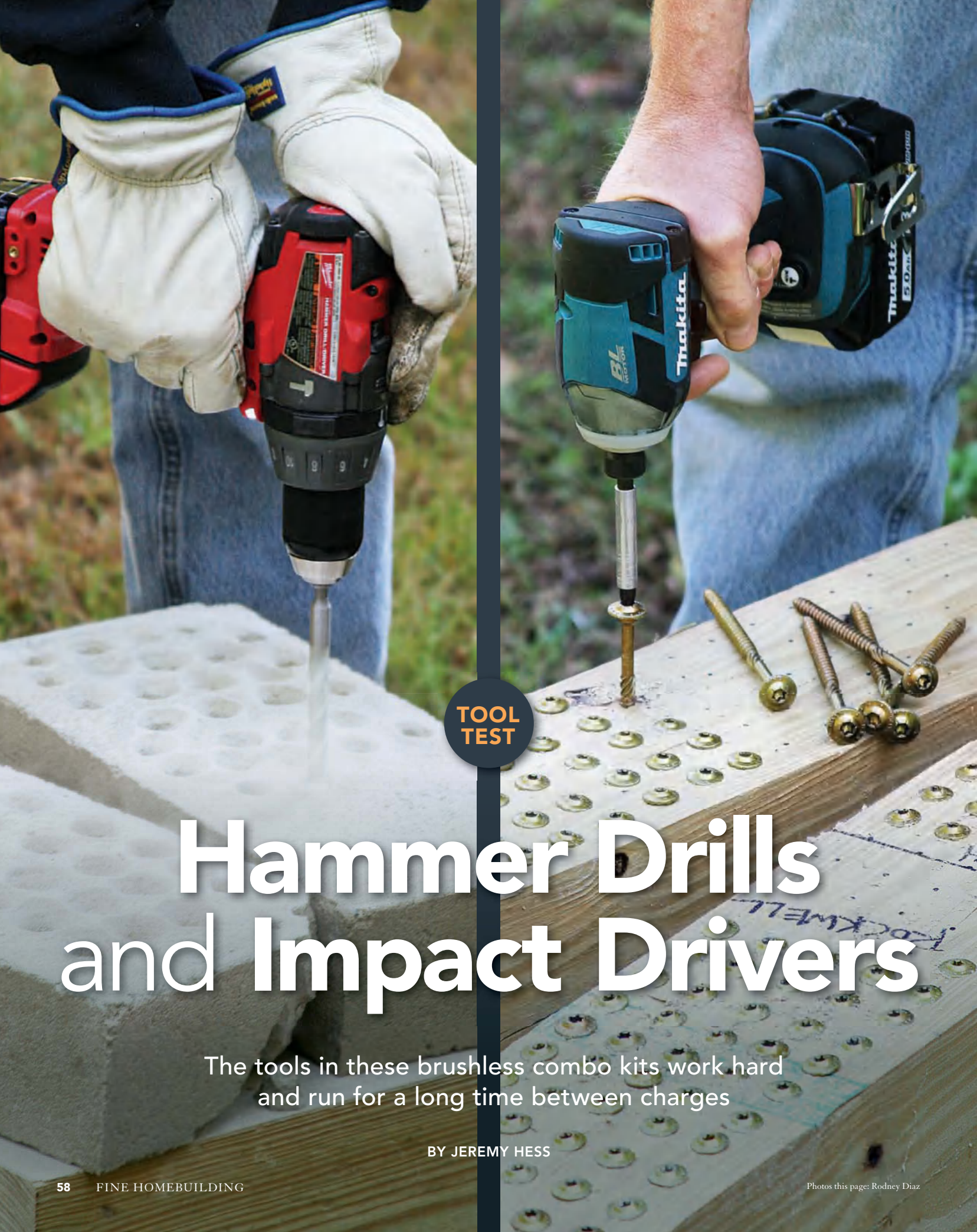
I did everything I could in the shop, including rabbeting the back of the fascia for the soffit panels, cutting the angled gable boards, and assembling the rake returns, box beams, and roof trusses. Of course, there's a limit to the size of such assemblies. They have to be small and light enough to be placed easily.

An advantage to working in the shop is that it keeps the material dry. Using dry stock is particularly important when cutting a project ahead of time, as any dimensional changes can throw the fit off. Expecting the wood to expand a little bit once it's exposed to moisture, I take the layout lines when cutting the framing. On the trim, I cut right to the lines, so it's a little bigger than the framing it will cover. I'd rather have to take a little off a piece of trim than have it be too short.

Once I was on-site for this project, the only measuring and cutting I had to do was on the two outer support posts. The post locations were not level with each other, and it was easier to account for this variance on-site. Because everything else was cut, with some of it built into assemblies in the shop, I just had to install it. I had printouts of my drawings and cutlist, so it was easy to check and cross-check as I went along, making sure that the components went together as planned.

I spent about two hours drawing the portico in SketchUp and making the cutlist. Shop work, delivery, and installation took an additional 59 hours, for a total of 61 hours. If I'd built the portico entirely on-site, I estimate that the job would have taken around 75 hours. The savings of 14 hours is not too shabby, and it doesn't include time saved by avoiding rain delays. Plus, some of that time was spent in a comfortable shop rather than out in the cold scratching my head. □

Michael Patterson is a contractor in Gaithersburg, Md., and the president of the Metro DC chapter of the National Association of the Remodeling Industry (NARI). Drawing and photos by the author, except where noted.



TOOL TEST

Hammer Drills and Impact Drivers

The tools in these brushless combo kits work hard and run for a long time between charges

BY JEREMY HESS

Photos this page: Rodney Diaz

BOSCH has more than 50 tools in its 18v Li-ion system and offers batteries rated up to 6 Ah. Three lights surrounding the chuck on the impact driver provide ample light no matter what the position of the workpiece. An unusual chuck accepts both ½-in. mechanics sockets and ¼-in. hex-shaped driver bits. I found two drawbacks to this design: First, the tool is larger than the others; second, some bit holders don't fully lock into place. However, it was convenient not to need socket adapters when installing lags or tightening foundation bolts. Installing a driver bit takes two hands—one to pull out on the collar and one to insert the bit. Although it's not a major issue, I find two-handed bit changes a little annoying. The light on the hammer drill is located above the battery and works well. Unfortunately, the hammer drill was the slowest in the concrete-block test.

DEWALT has more than 75 tools in its 20v Li-ion system and offers batteries rated up to 5 Ah. Three LEDs on the impact driver offer ample light around the driver bit, and the chuck allows you to push bits in without lifting the collar, making bit changes a one-handed operation. Along with the Rockwell, the DeWalt is the only impact driver that doesn't have adjustments for maximum speed and torque. This isn't an issue for deck builders or framers, but it's something to consider for electricians or finish carpenters. The hammer drill is well balanced, is easy to use in any position, and has minimal vibration, making it comfortable during extended drilling of concrete. The single LED light located above the battery does a good job of illuminating the drill bit. One worry: The kit I received arrived with two faulty batteries, although DeWalt quickly sent me replacements.

Bosch CLPK250-181L

PRICE $377
BATTERIES 2 Ah
WARRANTY
3 years (tools)
2 years (batteries)

24 Concrete holes drilled

Holes per Ah: 12
Time per hole: 47 seconds

40 Structural screws driven

Screws per Ah: 20
Time per screw: 9.5 seconds

DeWalt DCK286D2

PRICE $300
BATTERIES 2 Ah
WARRANTY
3 years (tools and batteries)

24 Concrete holes drilled

Holes per Ah: 12
Time per hole: 24 seconds

61 Structural screws driven

Screws per Ah: 31
Time per screw: 7.75 seconds

Cordless drills and impact drivers are as common on the job site as tape measures and hammers. Manufacturers are continually improving their tools and batteries in an attempt to build the cordless package that weighs the least, runs the longest, and stands up best to the rigors of job-site use. The latest improvement in this progression is brushless motors. I recently took a look at six brushless hammer-drill and impact-driver combo kits to evaluate their features and their performance in real-world tasks.

All of the kits come with two batteries and a charger and can be purchased as the base for a cordless-tool arsenal. Rockwell offers only two other compatible tools: an oscillating saw and an impact wrench. The other kits offer a larger selection of additional tools, ranging from circular saws and reciprocating saws to specialty metalworking tools and nailers. Manufacturers try to entice purchasers with low prices on these two-tool kits, hoping they'll buy additional tools and batteries later. This hope is justified, since most users want to stick with one battery platform.

Brushed vs. brushless motors

Whether corded or cordless, the typical tool motor is constructed of an armature, a commutator, and brushes. This type of motor is inexpensive to build and free of complex electronics. There are downsides, however. For example, the carbon brushes that ride against the commutator slowly wear away until they need replacement. Even worse, the drag created takes away from the useful power of the motor.

Instead of brushes, brushless motors have electronic circuitry that alternates the current to the motor's magnets to make the motor rotate. The absence of brushes eliminates the efficiency-robbing friction and allows for a more compact design for the motor and the tool. (For more on tools with brushed

HITACHI has 30 tools in its 18v Li-ion lineup. The 3-Ah packs included in this kit are the largest-capacity batteries the company offers. A single LED light above the trigger illuminates the lower side of the bit, creating a shadow, especially when you're holding a screw to start it. The impact-driver housing is among the largest in the test, and the small trigger's shape makes it uncomfortable to use the tool for extended periods. Changing bits requires two hands. The hammer drill also has a large housing, but the tool is well balanced and comfortable to use. A single LED light above the battery illuminates the work area well. There are two features of this kit that I would change. The light is turned on and off with a button rather than the trigger, and the fuel gauge is on the tool instead of on the battery. Having the gauge on the battery is far more useful.

Hitachi KC18DBFL

PRICE $280
BATTERIES 3 Ah
WARRANTY
lifetime (tools)
2 years (batteries)

52 Concrete holes drilled

Holes per Ah: 17
Time per hole: 39 seconds

64 Structural screws driven

Screws per Ah: 21
Time per screw: 10 seconds

MAKITA has more than 100 tools in its 18v Li-ion lineup, and the 5-Ah packs included in this kit are the largest-capacity batteries the company offers. The impact driver was the smallest of all the drivers in the test, which is great for hanging cabinets and working in other confined areas. The driver features three speeds plus a setting for driving self-drilling sheet-metal screws like those used for steel framing and installing ductwork. In this setting, the driver spins a screw at the optimal speed for drilling and then reduces the speed once the impacting starts. The single LED light produces a shadow if you use your free hand to guide a screw. Although the hammer drill was the heaviest of the bunch, it was comfortable to use. Unfortunately, the battery has to be on the tool to register the level of charge remaining. Other than that, this kit is almost perfect.

Makita XT252T

PRICE $459
BATTERIES 5 Ah
WARRANTY
3 years (tools)
1 year (batteries)

AUTHOR'S BEST OVERALL CHOICE

64 Concrete holes drilled

Holes per Ah: 13
Time per hole: 32 seconds

126 Structural screws driven

Screws per Ah: 25
Time per screw: 4.5 seconds

and brushless motors, see "How It Works," *FHB* #226).

Batteries vary

While all kits in this test contained lithium-ion (Li-ion) batteries, not all batteries had the same amp-hour rating. The higher the amp-hour rating, the more fuel the battery can hold. A higher amp-hour rating doesn't make the motor more powerful or increase performance; it simply means the battery has a longer run time. The tested kits have batteries ranging from 2 to 5 amp-hours (Ah).

Because of this variation, comparing the number of holes drilled or fasteners driven without some interpretation is not that meaningful. For each kit, then, I compared the number of holes drilled and fasteners driven to its batteries' amp-hour rating. This allowed me to evaluate performance on a more-level playing field. I also included the gross numbers because they matter, too, especially since batteries are a large part of a cordless platform's overall cost.

Shared features

The tools in all six kits in this test share many features. They come with some configuration of LED worklights, although the positioning and the number of lights vary, and some work better than others. All tools have a metal belt clip that can be mounted on either side of the tool.

Impact drivers are great for installing large screws and bolts and for tightening nuts. At full power, though, they're not well suited for smaller screws and tightening up delicate hardware, so all of the drivers except the DeWalt and the Rockwell have controls that slow the motors for greater precision when needed. This feature allows the same impact driver to go from installing ledger bolts for a deck to tightening canopy screws for a ceiling fan. Changing this setting is as easy as pushing a button.

MILWAUKEE has several battery options, including 9 Ah—the industry's largest—and there are more than 40 tools in its 18v Li-ion lineup. The impact driver's chuck allows you to lock in a bit without pulling a collar. The LED light above the trigger provides plenty of illumination, but like all lights located in this position, shadowing can be an issue. There are three speed/impact settings, and the grip is comfortable, even during extended use. The hammer drill is heavier than most of the others but is well balanced and comfortable to use. This kit is one of my favorites in the test. The only problem is the blow-molded case, which, despite its size, lacks any real storage space for bits and accessories.

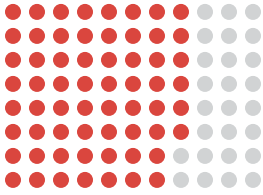
ROCKWELL has 2-Ah batteries and offers just two other tools in its 20v Li-ion lineup: an oscillating multitool and an impact wrench. This is the kit's biggest downside, as both the impact driver and the hammer drill offer performance and run time on par with better-known brands. The impact driver feels a little top heavy and is slightly larger than the other impact drivers. The single LED above the trigger provides decent light, but it doesn't have the beam spread of the tools with multiple LEDs. The chuck requires two hands to insert a bit. The hammer drill is well balanced and comfortable to use, and its single LED above the battery illuminates the work area well. This kit is best suited for someone who needs only an impact driver and a hammer drill. One huge perk: If you register the tool, Rockwell offers a 20-year warranty, including batteries.

Milwaukee 2797-22

PRICE $350
BATTERIES 4 Ah
WARRANTY
5 years (tools)
3 years (batteries)

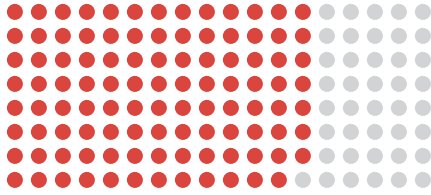
AUTHOR'S BEST VALUE CHOICE

62 Concrete holes drilled



Holes per Ah: 16
Time per hole: 23 seconds

103 Structural screws driven

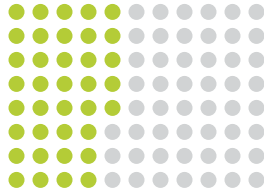


Screws per Ah: 26
Time per screw: 5.2 seconds

Rockwell RK1807K2

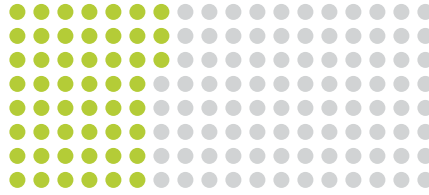
PRICE $275
BATTERIES 2 Ah
WARRANTY
20 years (tools and batteries)

37 Concrete holes drilled



Holes per Ah: 19
Time per hole: 28 seconds

51 Structural screws driven



Screws per Ah: 26
Time per screw: 4.5 seconds

All of the hammer drills have two speeds and multiposition clutches.

Top picks

The two kits that I reached for the most were the Makita and the Milwaukee. The Makita impact driver fastens more screws faster than any other impact driver tested, so its kit is my pick for best overall. Because the Milwaukee kit costs $109 less than the Makita, I made it my best-value choice. □

Jeremy Hess is a remodeler in Elizabethtown, Pa. Photos by Patrick McCombe, except where noted.

How we tested

In addition to using the kits on my job sites for several weeks and loaning them to friends in the trades for their input, I did some standardized tests to check battery life and drilling/driving speed. To test the impact drivers, I drove ⅜-in. by 5⅛-in. GRK structural screws into a pressure-treated 6x6 post. Starting with a fully charged battery, I ran the big screws one after another until the battery's electronic circuitry cut power to the motor. I did three trials of each tool and averaged the results. To test the efficiency of the hammer drills, I drilled ½-in. holes into 4-in. solid concrete blocks until the batteries died. In this case, I did two trials and averaged the results.

Build a High-Performance Exterior Door

This beautiful door is ideally suited to energy-efficient homes and can be made with common building materials

BY BEN GRAHAM AND MIKE LAMP

We recently completed a deep-energy retrofit to an 80-year-old Vermont farmhouse. The many improvements we made included new windows, new mechanical systems, and the addition of 4 in. of exterior mineral-wool insulation. Not surprisingly, the project also called for new energy-efficient exterior doors to complement the home's high-performance building envelope.

For an ultra-efficient house like this one, entry doors are often sourced from Europe, where high-performance doors are more mainstream than in the United States. Unfortunately, most European offerings have a sleek, modern appearance, and our clients wanted something that would fit the style of their farmhouse. With limited options, we set out to build a pair of attractive entry doors that would rival the efficiency of the best-performing units on the market. In addition, we wanted to do so by using common building materials that are readily available.

The 3½-in.-thick R-10 doors that we built are made from site-harvested cherry. They are filled with 2-in. rigid-mineral-wool insulation and include triple-pane low-e glass. We installed the doors in custom-built jambs with a crucial double-weatherstripping detail to help make the entry airtight. Finally, we outfitted each door with the best-built hardware we could find.

Aesthetics and performance drive design

One of the first decisions we had to make was whether to build inset or overlay doors. In the United States, virtually all residential entry doors are inset. The door swings into the frame and lands on a stop. High-performance European doors, which are described as overlay, close onto their frame. Proponents of overlay doors say they seal tighter and are therefore more efficient. However, overlay doors require rabbeted or post-style hinges, which are costly and hard to find in the United States. Rather than order hinges from Europe for several hundred dollars, we decided to build inset doors and add a second layer of weatherstripping to boost their airtightness.

For weatherstripping, we opted to use silicone flipper seals from Research Conservation Technology (conservationtechnology.com) along the head and side jambs. These soft silicone weatherstrips easily compress to accommodate a wood door's seasonal movement, and they make the door easy to close. The strips are installed in one sawkerf that aligns with the door's rabbeted edge and in a second kerf cut into the applied stop. On the bottom of the door, we installed a brushed sweep to seal the door to its bluestone threshold.

Perhaps the most challenging aspect of the doors' design was finding suitable hardware. For high-performance homes, we encourage all of our clients to select multipoint locks for their doors. The bolts at the top and bottom can help prevent a wood door from warping, increase airtightness by providing even pressure against the door's weatherstripping, and boost security. Multipoint locks are relatively easy to get through special order, but finding a setup that works with a 3½-in.-thick door is not as easy. In

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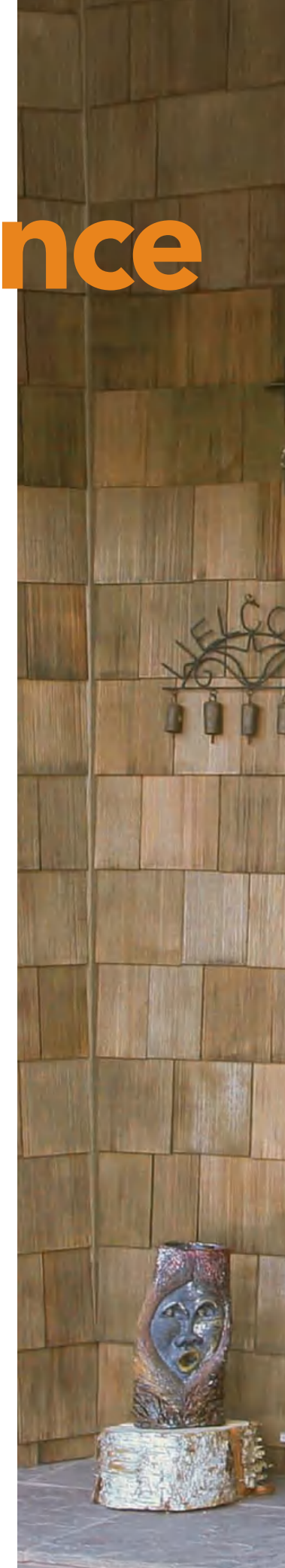


Product photos: Rodney Diaz

HIGH-PERFORMANCE COMPONENTS

An ultra-efficient entry door depends on durable, high-quality components. Weatherstripping, glass, and insulation all contribute to a door that looks good, saves energy, and operates easily.

INSULATED GLASS

Triple-pane low-e glass with 0.24 U-factor

cardinalcorp.com

WEATHERSTRIPPING

WS64 brush sweep

GG05 foam weatherseal

WS15 silicone weatherstripping

conservationtechnology.com

INSULATION

Roxul ComfortBoard IS mineral wool

roxul.com

AN INSULATION SANDWICH

Once all of the door's parts were milled, the exterior-side components were assembled by capturing the tongue-and-groove planks that make up the door's lower half in a glued-up frame. It was critical for all of the parts to be in perfect alignment so the cleats that attach the front of the door to the back would fit without struggle. The rest of the assembly was driven largely by an anticipation of wood movement and attention to airtightness.

Drive in the cleats. *Once the glue is dry on the exterior panel, the three cleats are driven into the sliding dovetails. The cleats are made from two layers of quartersawn white oak with a 1-in. XPS-foam thermal break in between. They are held together with countersunk ¼-in. bolts.*

Add an air barrier. *The tongue-and-groove boards that make up the front and back panels are gasketed for weathertightness, but a breathable weather barrier on the exterior side of the door provides a second line of defense. It's sealed to the door skin with weathersealing tape.*

Assemble the back. *With the door's center already insulated with 2-in. rigid mineral wool, the boards that make the door's interior panel are slid on the dovetails one at a time. Paste wax makes the process easier. The center board has tongues on both edges to receive boards on both sides.*

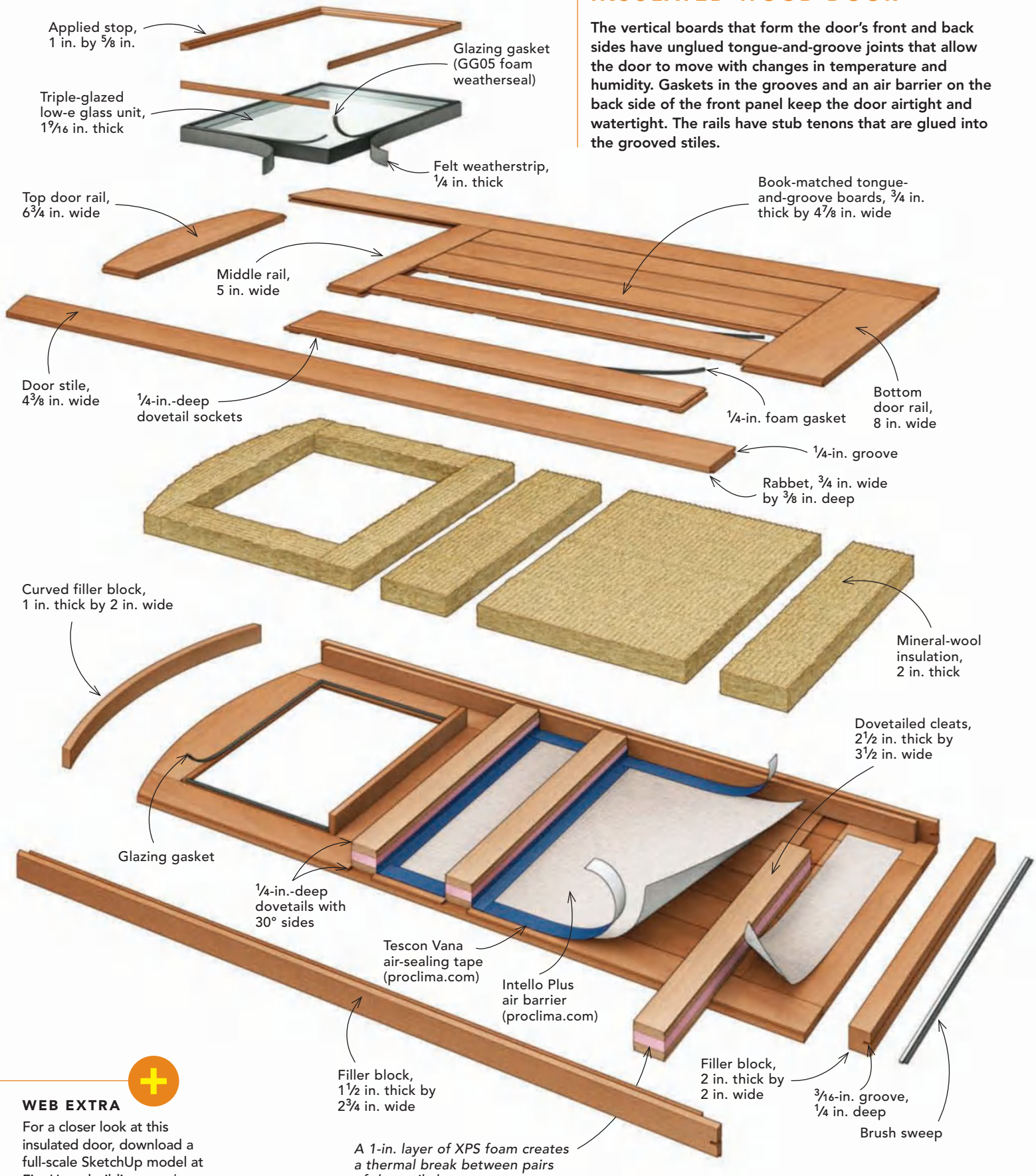
Glue up the panel. *The stub-tenon joints where the door's rails and stiles meet are secured with waterproof glue and then clamped with pipe clamps. Temporary spacers (card stock about 3/32 in. thick) ensure even gaps between the tongue-and-groove boards during assembly.*

Cut the arched top. *The door has an arched top that's cut in three passes with a router on a trammel arm. With the door's curved top as a starting point, curved laminations of 3/16-in.-thick stock will be made later for the door's top edge, head jamb, and curved stops.*

Drawings: Christopher Mills

A LOOK INSIDE AN INSULATED WOOD DOOR

The vertical boards that form the door's front and back sides have unglued tongue-and-groove joints that allow the door to move with changes in temperature and humidity. Gaskets in the grooves and an air barrier on the back side of the front panel keep the door airtight and watertight. The rails have stub tenons that are glued into the grooved stiles.



WEB EXTRA

For a closer look at this insulated door, download a full-scale SketchUp model at FineHomebuilding.com/extras.

A HEAVY DOOR IN A THICK WALL

The home's 4 in. of exterior insulation meant that the door jambs had to be 11 in. wide, so they were built in two parts with the joint hidden by the applied stop. The stop has two layers of soft silicone weatherstripping, ensuring that the door is airtight but closes easily. To stop air infiltration further, the home's water-resistive barrier was carefully taped to the jambs with air-sealing tape.

Fasten the jambs and install the stop. *Once the side jambs are plumb and securely fastened with structural screws, the first layer of the two-layer stop is fastened to the head jamb with 1-in. screws. Then the side stops are coped around the head stop and screwed in place. The screw heads will be hidden by the second stop.*

Hang the door. *Once the first-layer stops are in place, the door is hung from its hinges and closed. The second stop is then held tight to the door and fastened through counterbored holes that will be filled with grain-matched cherry plugs later.*

Slip in the jamb extension. *Once both stop layers are in place, the assembled, three-sided jamb extension is fit to the main jamb with a rabbeted half-lap joint. A ¼-in. gap in the joint between the main jamb and the jamb extension allows for seasonal expansion. The gap is hidden by the stop.*

Continued from p. 62

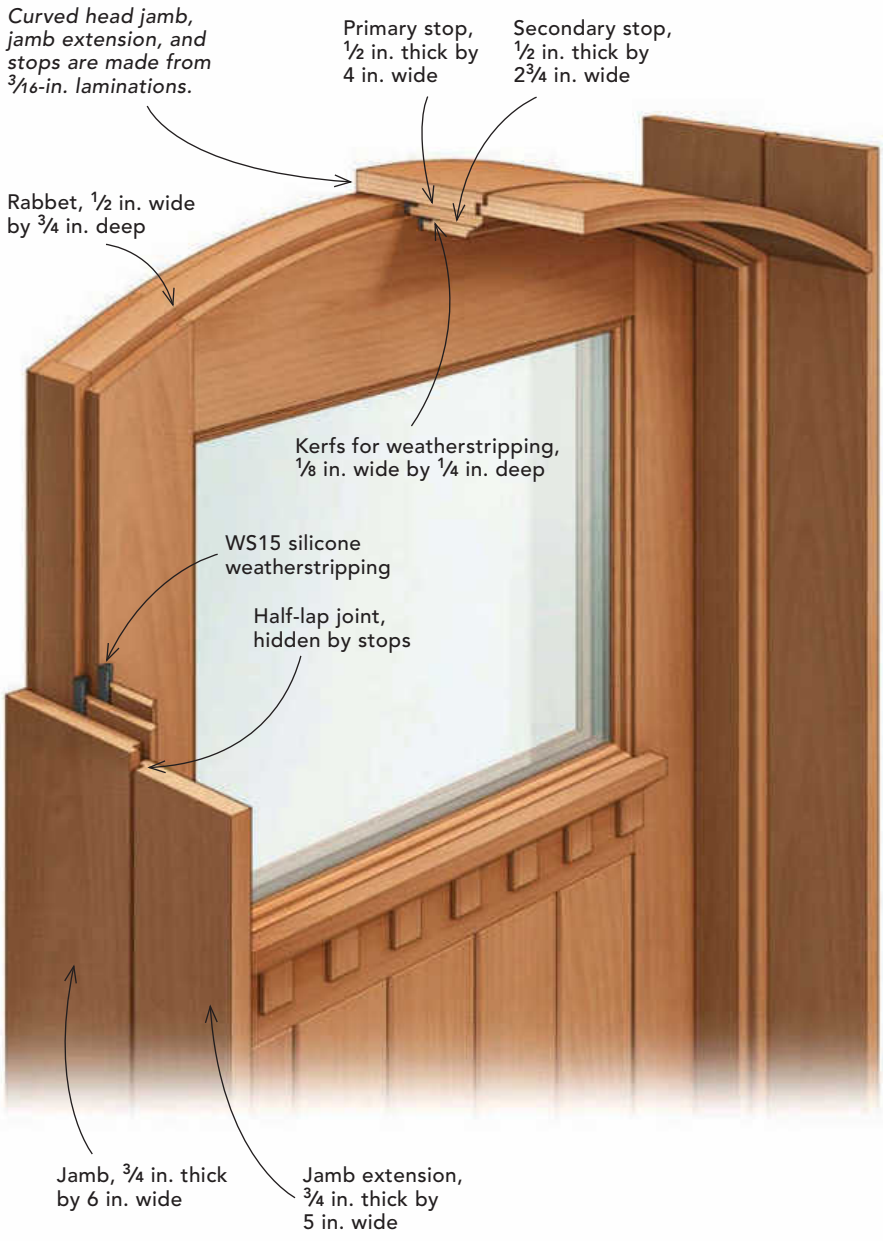
fact, the units we found that would fit are distinctly modern in appearance. Given the options, our clients decided to forego the multipoint lock and instead install a high-quality traditional mortise lockset from Rocky Mountain Hardware, which accommodates the door's thickness and is in tune with the farmhouse style.

Another essential component was the glazing, as each door's design included a window, a thermal weakpoint in any entry door. To retain efficiency, we selected triple-pane low-e glass panels from Cardinal Glass. The 1⁹⁄₁₆-in.-thick insulated windows have a U-factor of 0.24, which is roughly the equivalent of R-4.

Performance hinges on installation

We assembled the doors and jambs in the shop to make installation easier. The doors are installed like any other prehung unit, with some extra complications due to their 140-lb. weight and their two-part jambs that accommodate the home's extrathick walls.

We devoted the same amount of attention to insulating and air-sealing during the installation that we put into the construction of the doors so that air leaks would not compromise the doors' efficiency. We started by pulling the hinge pins and removing the door from the jamb. We then shimmed the hinge-side jack stud plumb with flat shims



Install the casing. *The jambs are taped to the house's water-resistive barrier with air-sealing tape, and then the casing is installed with screws. The screw holes are counterbored so they can be plugged later.*

and screwed the door frame to the jack studs with structural screws, being careful to place the screws so they'd be hidden later by the applied stop. We then installed the jamb extensions, which are joined to the structural jambs with a rabbeted half-lap joint. The joint is also hidden behind the stop, which makes the two-piece jamb look like a single piece of wood. We carefully taped the door frame to the home's housewrap with air-sealing tape and then filled around the frame with canned spray foam before installing flat casing that matches the home's window casing.

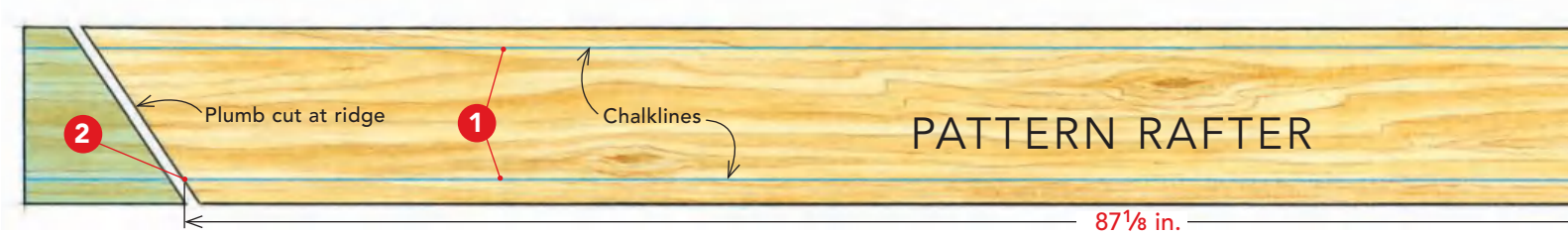
Doors like this aren't cheap, but they cost about the same as high-end entry doors from Europe. Prices for the type of hardware we installed range from $500 to $1500. Each door required 100 hours of custom woodworking labor, 60 board feet (bd. ft.) of 4/4 cherry, 15 bd. ft. of 8/4 cherry, and 8 bd. ft. of 4/4 red oak. The doors have performed admirably during Vermont's frigid winter weather, keeping the homeowners comfortable and saving energy. But more than that, we all think the doors look great, and so does everyone else who visits the house. □

Ben Graham is part owner of New Frameworks Natural Design Build in Burlington, Vt. Mike Lamp is the owner of West Barnet Woodworks in Barnet, Vt. Photos by Patrick McCombe, except where noted.

Perfect Roof

Focus your efforts on the pattern rafter, and the rest of the roof falls into place easily

BY SAM KOERBER



1 ***Start off straight.*** *Mark 1 in. and 8 in. from the top edge on both ends of a 2x10, then snap a crisp chalkline between each pair of marks (0.5mm string is best) to create dead-straight reference lines.*

2 ***Mark the ridge plumb cut.*** *Align your framing square to the chalkline on the appropriate numbers—the 8-in. and 12-in. marks for this 8-in-12 pitched roof—and scribe a line for the ridge plumb cut. I use a utility knife for all cross-grain marking because the knife line is more accurate than the sharpest pencil line, and it shears off cleaner when cut with a circular saw.*

My process for framing a roof starts the same as anybody else's: laying out and cutting a pattern rafter, which I then use as a template to cut the rest of the rafters to make up the roof frame. Just like everybody else, I choose a flat, straight, and dry piece of stock for the pattern rafter, which I crown so that any natural arch is facing up when installed, and I set the piece atop a pair of sturdy sawhorses that are at a comfortable working height. From there, I get a bit more fussy than most with the layout, which I believe pays off big time in terms of the quality of my frames.

Lessons learned from timber framing

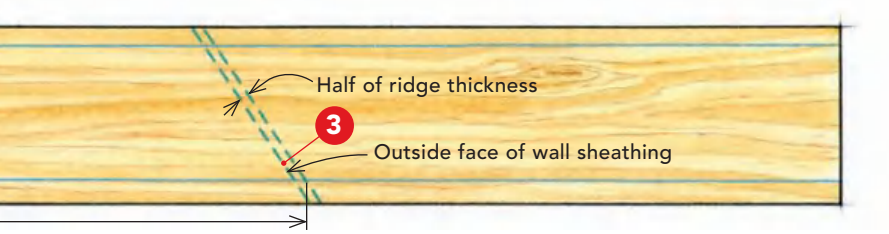
Most of the time, framers use a 6-in. rafter square to lay out the plumb and seat cuts of a rafter. But two practices on recent jobs have convinced me to change up my approach. First, I've begun to incorporate components of timber framing into otherwise stick-framed houses; second, I do exposed rafter tails on most builds. Timber framing has taught me to use chalklines and a framing square for accurate layout on boards that don't have a reliable straight edge for reference. It also has taught me that a knife makes crisper layout lines than a pencil. Those same layout techniques have improved the consistency of the

Drawings: Don Mannes

Rafters

FINDING THE RAFTER LENGTH IS EASY

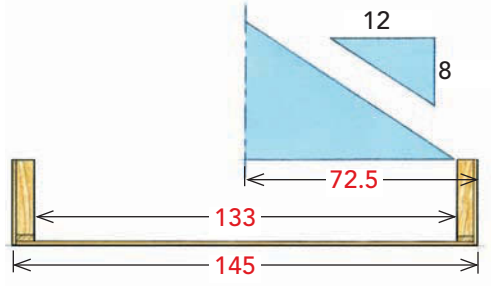
All you need to find the length of a rafter is the width of the building, the desired roof pitch, and a basic calculator. The math may look intimidating at first, but go through the steps once and you'll see how easy it is.



3 ***Follow the line.*** *Measure from the intersection of the chalkline and plumb cut—starting from the 1-in. mark for accuracy—to mark the rafter length. Adjust this line by half the thickness of the ridge to mark the plumb line that represents the sheathing's outside face.*

exposed rafter tails, ensuring that they not only look crisp and uniform but that they line up nicely without trimming and shimming once in place. Now, even on roofs without exposed rafter tails, I use this technique because it works better than the conventional methods.

Lumber, even the dimensioned stock we use for framing, is far from perfect. Referencing the ridge, seat, and other cuts off the edge of a board can throw off the layout more than you might think. Wany edges from the milling process, natural dips and humps in the board, and knots and other grain patterns all affect the trueness of a board edge. The conventional approach means trying to fit a long 2x



Measure between the insides of the plates at the bottom of the wall (the easiest place to get an accurate read), and then add in the plate width and sheathing thickness:

133 in. (plate to plate) **+ 12 in.** (total combined width of plates and sheathing) **= 145 in.**

A standard gable has two rafters that meet in the middle, so divide this number in half:

145 in. ÷ 2 = a rafter run of 72.5 in.

The roof pitch provides the next two numbers in the calculation. We want an 8-in-12 pitch, so multiply the run by 8, then divide the result by 12 to get the rise:

(72.5 × 8) ÷ 12 = a rafter rise of 48.33 in.

The key formula here is $a^2 + b^2 = c^2$. Plugging the run and rise into the formula lets you solve for c, the rafter length:

$72.5^2 + 48.33^2 = 7592.0389$

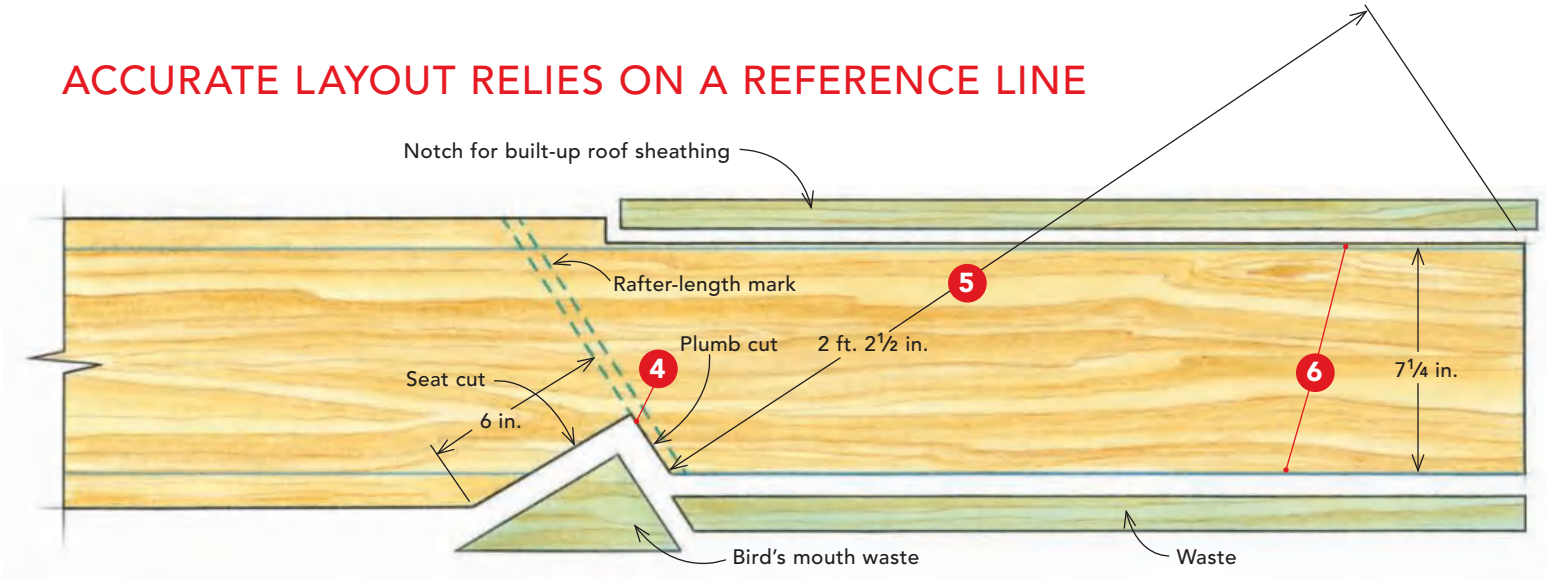
Hit the √ to find the square root, which is **87.134 in.**

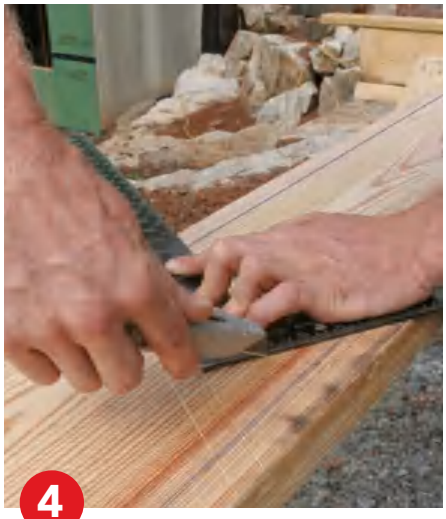
Carpenters don't deal in decimals, but converting the 0.134 remainder into 16ths is simple:

0.134 × 16 = 2, which is 2/16, or 1/8 in.

The final calculated rafter length is **87 1/8 in.**

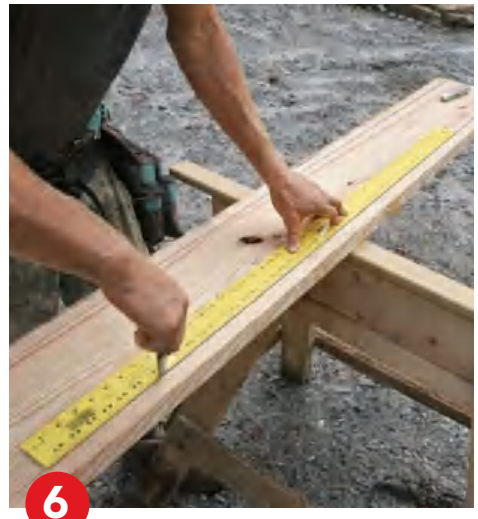
ACCURATE LAYOUT RELIES ON A REFERENCE LINE





4 ***Square up for the seat cut.*** *The bird's mouth is 6 in. wide—the combined width of the top plate and the wall sheathing—and referenced off the line that marks the rafter length.*

5 ***Add the overhang.*** *Reference your framing square off the plumb cut of the bird's mouth to calculate the desired amount of overhang, which is measured perpendicular from the bird's mouth plumb cut.*



6 ***Cut the tails.*** *Use the chalkline as a reference when marking the depth of the notches on the top and bottom of the tail, and connect them with a sharp pencil, which won't wander to follow the grain.*

MAKE CUTS WITH CARE

Start with the bird's mouth. *Penciled-in arrows ensure that the seat and plumb cuts are made on the right side of the knife line. Stop the sawblade where the lines intersect to avoid overcutting.*

Next come the cutouts. *Working from the plumb cut in, cut along the pencil lines to create the clean-cut 2x8 rafter tail.*

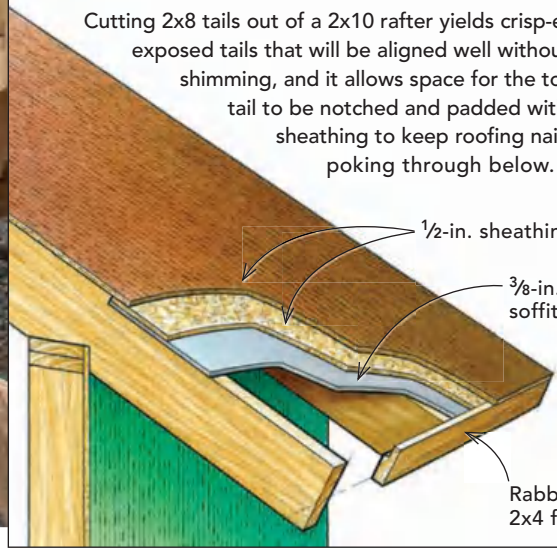
Finish up with a chisel. *A few whacks on the end of a sharp chisel make quick work of removing the waste from the corner of the bird's mouth.*

THE PATTERN IS SET

Add blocks. *The rafter template is completed with a reference block screwed near each end of its top edge to ensure that the peaks and tails all line up, regardless of crowns in the middle of the board.*

WELL-TAILORED RAFTER TAILS

Cutting 2x8 tails out of a 2x10 rafter yields crisp-edged exposed tails that will be aligned well without shimming, and it allows space for the top of the tail to be notched and padded with built-up sheathing to keep roofing nails from poking through below.



between walls and roof when the layout of the angles is based only on the 6 in. of wood that is directly in contact with the rafter square. Snapping your reference lines eliminates the inaccuracies.

Trust your rafter

Does such a fussy level of accuracy really matter with rough framing? My answer is that it's not about being perfect for the sake of perfection; it's about making the rest of the job go easier. If I'm confident that my rafters are laid out and cut to a high level of accuracy, I can trust them. This way, if they don't fit perfectly, I have a clue that something else in my framing is out of whack and needs to be adjusted. Maybe the top plate is a little crooked, the walls are slightly out of plumb, or the ridge board is cupped, crooked, or set too high or too low. Two wrongs don't make a right, and correcting these other components makes more sense to me than altering the ridge or seat cuts of a perfect rafter to fit a problematic frame.

I've found this process to be well worth the extra time spent doing layout. It's satisfying to be able to maintain control over the building throughout the roof framing process. □

Sam Koerber is a builder in Asheville, N.C. Photos by Justin Fink.

Is Solar

Photo: Topher Donahue/Aurora Photos/Corbis

the Solution?

Solar panels might be a wise investment in light of a generous federal tax credit set to expire by 2017

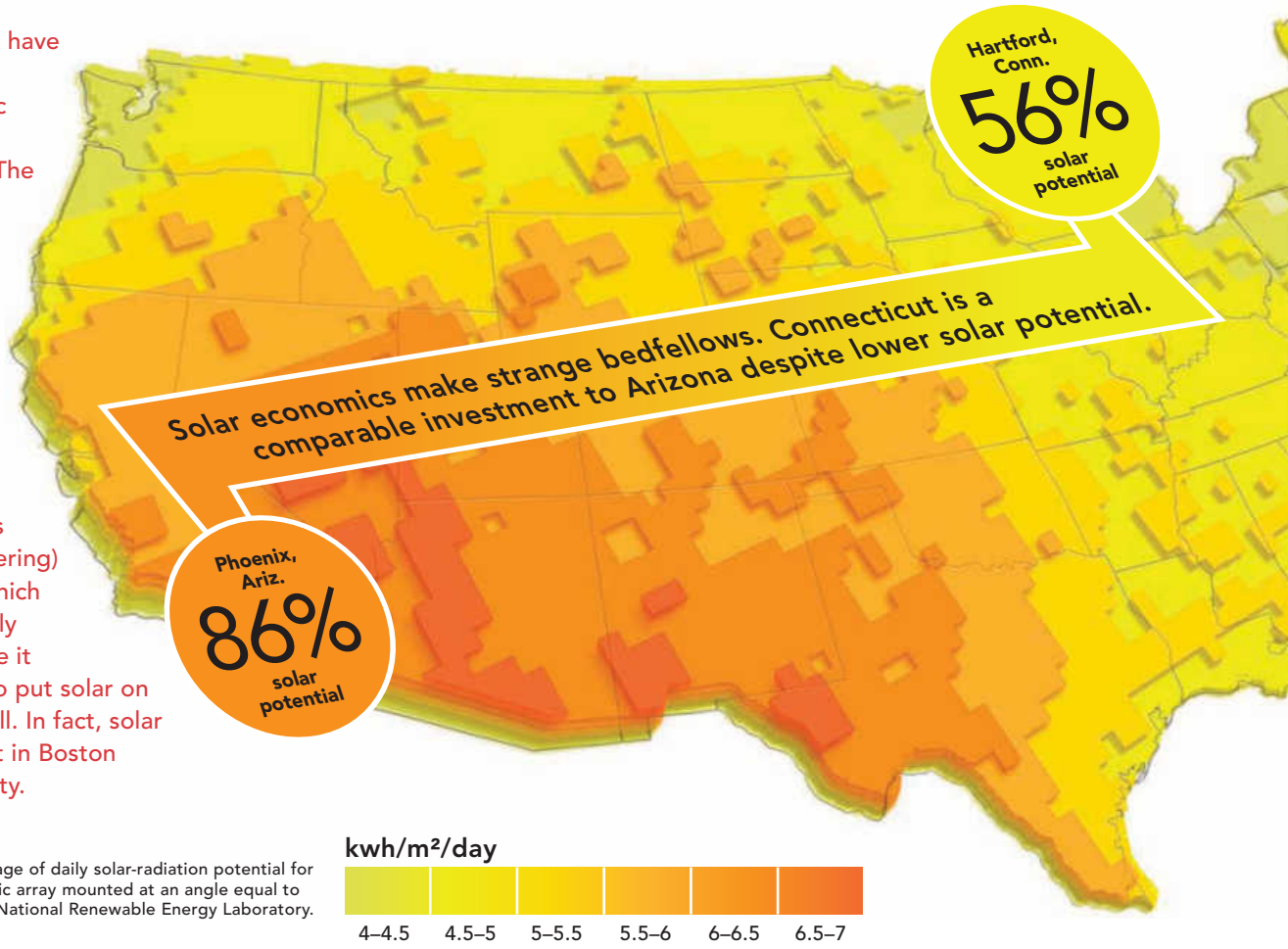
BY SEAN GROOM

Tracking the prices of energy and gasoline is a staple of news reports, but those same reports largely have ignored the steep decline in the cost of photovoltaic (PV) systems—from over $10 per watt in 2000 to around $3.48 per watt in the first quarter of 2015. At this price, solar installers say that there's never been a better time to go solar, and steadily rising electric rates suggest they're right—in principle. However, most Americans are daunted by the perceived substantial cost of a PV system—*perceived* because the average homeowner finds the incentive-riddled pricing structure of PV systems to be murky, is unaware that prices have fallen dramatically, and is often not sure if electric rates are high enough to offset an investment in solar.

Many homeowners still believe that solar is for the wealthy. SolarCity CEO Lyndon Rive has acknowledged in interviews that his company wants to remove the stigma of high costs from solar power. For those who can't afford

PV PARITY

In theory, solar arrays have the biggest payoff in regions where electric rates are high and sunshine is plentiful. The map shows the solar potential of different areas of the country. Phoenix clearly has much more solar potential (86%) because of the amount of sunlight it receives, yet the high utility costs and favorable policies (rebates and net metering) in Hartford, Conn., which has cloud-free sun only 56% of the year, make it economically viable to put solar on your roof there as well. In fact, solar is a better investment in Boston than in any Arizona city.



Map indicates an annual average of daily solar-radiation potential for a south-facing flat photovoltaic array mounted at an angle equal to its latitude. Data courtesy of National Renewable Energy Laboratory.

the up-front cost of purchasing a PV system—and at $13,000 for an average 5kw array after incentives (give or take a few grand), that's a lot of people—solar companies offer financing and leasing plans to replicate the traditional monthly electric payment. They have made going solar more attractive by reducing homeowners' monthly payments and offering price stability over 20 to 30 years.

Solar panels reduce the amount of grid-supplied electricity you must purchase and can be considered an energy-conservation strategy. Unlike with weatherization improvements or switching heating fuels, both the cost of the work and the amount of financial savings with solar are calculated accurately beforehand. If you're looking to save money, it's a straight-off-your-bill deduction independent of other efficiency improvements. To figure out the payoff of adding solar to your rooftop, you need to weigh your electrical usage against the solar potential of your property and compare your utility rate to the installed cost of a solar array.

Supply and demand in an economy of one

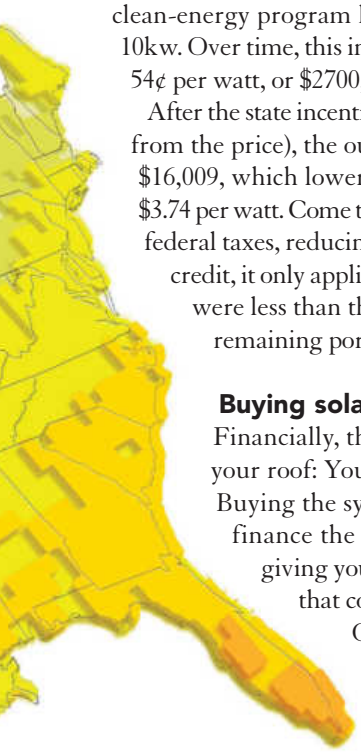
To get a grasp on your personal solar economics, you first need to calculate your demand. Gather the last year (two years if you can) of electrical bills, and tally your monthly usage to arrive at your annual consumption. This is your demand expressed in kilowatt hours (kwh). Last year, for example, my family used 5700kwh. We live in Connecticut and have fairly high utility rates: Our generation charges are 20¢ per kwh, and with transmission and distribution charges, we paid $1200 to power our house for the year.

Supply is the amount of electricity you can produce, in most cases from a rooftop system but alternatively from a ground-mounted array. You can estimate this using the National Renewable Energy Laboratory's PVWatts calculator (pvwatts.nrel.gov). Using satellite-mapping photos, the calculator allows you to mark the area of your roof available for panels and to adjust default variables such as roof slope. The calculator combines this information with geographic, climate, and economic data, and then it spits back the size of the system that will fit on the roof and the amount of energy it will generate during the year. For my roof, it was a 5kw system that would generate 6176kwh per year of electricity—more than enough to offset my annual usage of 5700kwh. Solar companies also perform this calculation, but with an on-site visit to account for shading.

Now that you know demand and supply, the price of the solar array will determine whether it makes sense to purchase one. In July 2015, Sungevity quoted a price of $18,709 for a 5kw system in Connecticut. However, the quoted cost is not the full story. Although state and local incentives generally are winding down, there are still plenty of rebates in force. (You can find state, municipal, and utility incentive programs in the dsireusa.org database. Solar companies in your area

also know the current incentives.) Here in Connecticut, the state's clean-energy program has an incentive for rooftop systems up to 10kw. Over time, this incentive has been reduced, but in July it was 54¢ per watt, or $2700, for a 5kw array.

After the state incentive (paid to the solar company and deducted from the price), the out-of-pocket cost in my example would be $16,009, which lowers the installed cost to $3.20 per watt from $3.74 per watt. Come tax time, I'd be eligible for a 30% credit on my federal taxes, reducing the final cost to $11,206. Because it's a tax credit, it only applies to my tax liability for the year. If my taxes were less than the credit—in this case, $4800 in 2015—the remaining portion of the credit would roll over to 2016.



Buying solar panels is an investment

Financially, there are three ways to get a PV system on your roof: You can buy it outright, finance it, or lease it. Buying the system—whether you pay cash up front or finance the purchase—has the distinct advantage of giving you ownership of the array and the incentives that come with ownership.

Often potential solar customers look at simple payback. Divide the cost of the PV system by the average monthly electric-bill savings, and you've got the number of months until the savings have paid for the system. In my case, this would be during the ninth year, which would make the next 15-plus years of electricity free. An alternative is to divide the total cost of the system—$11,206 in my case, plus $3000 to replace the inverter at some future time—by the total anticipated electrical output over an estimated 25-year life span of the array: 154,400kwh. That works out to roughly 9¢ per kwh (which may be slightly higher depending on how much the panels degrade over time). This simple cost calculation is significantly less than my utility rate, which will increase regularly. Paying for a PV system up front will put a dent in your savings, but it will improve your monthly cash flow—noticeably if you have high electric bills. But financing a PV system may be a better option if you look at going solar as an investment.

The success of many large, national solar companies allows them to offer low-interest, long-term financing for solar arrays. For instance, a $16,000 loan at SolarCity's July 2015 terms (4.5% for 30 years) means that the monthly cost of a fully financed 5kw system is about $81 (plus you get to take the federal tax credit). If your electric rates are high enough to generate significant savings with PV and incentives remain, fully financing an array can gain you a better return even if you have the cash to buy it outright.

Going Solar in America, a recent report by the N.C. Clean Energy Technology Center, compares the net present value (NPV) of purchasing an array to the NPV of financing an array. NPV shows the future (25 years) value of the solar array in present-day dollars. Among the data *Going Solar in America* reports is that the NPV of a 5kw array purchased with cash is $6275 in Boston and $14,987 in San Francisco. Fully financing the same array changes the NPV to $11,830 in Boston and $21,859 in San Francisco. Overall, the report finds that the up-front purchase of a 5kw solar array in 20 of the 50 largest cities in the United States is a better investment than the Standard & Poor's 500 stock index (assuming a 6.61% annual return). But fully financing the array makes it a better investment in 42 of those cities. In regions with low electric rates and/or solar-unfriendly regulatory policies, it's tough to make a return at all on the investment. In Jacksonville, Fla., for example, the NPV of a fully financed array is $2104, but if it's paid for up front, the NPV is –$3871.

As with any investment, it's important to know how liquid it is. If you decide to move, will your home's sale price reflect a premium for the solar array? The Lawrence Berkeley National Laboratory recently compared the sales of almost 4000 homes with solar panels between 2002 and 2013 to a pool of nearly 19,000 non-PV homes picked to match the features of the PV homes (house size, lot size, number of bedrooms, etc.). It found that a solar array adds an average of about $4 per watt to the sale price of a house and that the PV premium over time tended to decline, accounting for falling equipment prices and rebates. (One caveat: The sample for the study didn't allow researchers to look at resale pricing on PV systems more than 10 years old, but it appears that homebuyers depreciate the value of panels quickly.)

Lease plans have broadened the market

Solar companies have used lease and power-purchase agreements (PPA) to broaden their market appeal. Households are used to paying a monthly utility bill; if a solar company can take a cut of that monthly payment and lower the monthly bill for the homeowner, they both win. With a lease, the homeowner pays rent on the equipment and gets the solar production as part of the bargain. The monthly payments are defined for the life of the lease. With a PPA, the equipment is installed free of charge, and the homeowner pays for all the electricity the array produces. The monthly payments are per kwh of

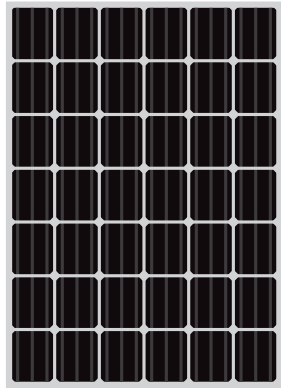
PV PAYMENTS: BUY vs. FINANCE vs. LEASE

The cost of a solar array varies around the country and is affected by hardware costs, demand, and the cost of grid electricity. In many markets, competition is intense, so it's worth getting several estimates to find the best price. The chart shows the average cost of a 5kw array in three states according to SEIA and GMT Research's *Solar Market Insight* report for the second quarter of 2015.

LOCATION OF 5kw ARRAY	BUY Before incentives	FINANCE 0% down, 4.5% APR for 30 years	30-YR. LEASE First year (3% annual increase)
California	$21,550	$109 per mo.	$168 per mo.
Texas	$17,900	$91 per mo.	$115 per mo.
Massachusetts	$24,700	$125 per mo.	$130 per mo.

electricity, typically at or slightly below the retail cost of grid electricity. For both leases and PPAs, there typically is an escalation clause of between 2% and 3% annually. (Nationally, the average utility-rate increase since 2002 is about 4% a year.)

There are some conventions of the leasing and PPA process to know about before meeting with a solar company's representative. If you choose a lease or a PPA, the company installing the panels owns them and cashes in the credits and/or rebates. Another critical thing to know is that leases and PPAs are 20-year contracts. That means if you decide to sell your house, you may be limiting the pool of potential buyers. If the potential buyer doesn't want to (or isn't approved to) assume the lease, you are responsible for paying the remaining amount due.



Households are used to paying a monthly utility bill; if a solar company can take a cut of that monthly payment and lower the monthly bill for the homeowner, they both win.

Turning the grid into a storage device

Most homes with solar panels are not defecting from the grid. When the PV system produces more electricity than the house is using, the surplus is diverted to the local grid and is consumed by neighbors. When PV production is less than the household's demand, it draws electricity from the grid. The meter keeps track of inflows and outflows, "netting" the monthly usage.

Net metering is an accounting method that lets homeowners effectively time-shift their production and consumption of energy, a critical feature in the economics of residential solar power. The amount of solar energy generated throughout a day varies with the sun's path. Production also varies with the season, diminishing during the winter from shorter, cloudier days and a lower sun path. With consumption waxing and waning throughout the day and the year, peak-use times don't necessarily match up to peak-generation times. Net metering can be understood as a way to turn the grid into a giant storage device that allows homeowners with PV systems to bank excess electricity from high-production periods and then consume it when their demand exceeds their panels' production.

Net metering is required by law in 43 states and the District of Columbia, but the conditions vary. The most advantageous net-metering rules allow homeowners to carry over surpluses from month to month. In these situations, if the array produces more electricity than the home consumes during a month, the utility company issues a credit for the excess production that is rolled over to count against consumption in the upcoming months. In most cases, the homeowner must use up this credit during the solar year, which often runs from July 1 to June 30. If there's a surplus at the end of the year, the credit may expire or the utility may cash out the excess production at a specified tariff. Valuing that excess production has become a matter of dispute.

In most locations, the price a utility assigns to solar electricity is very low because the utility pays the wholesale rate for electricity, also known as the avoided cost, rather than the retail rate that homeowners think of as the price of power. Because reimbursement is so low, it doesn't make sense to invest in an oversize system that will generate a surplus of electricity over the year. That's one reason why checking your historical use when you size the system is important. Another reason is that local incentives may be based on historical usage. Even if that's the case, it's worth considering any future changes to your electricity consumption before sizing the array. If you plan on building an addition, installing a pool, adding central air-conditioning, switching from natural gas or oil to electric, or purchasing a plug-in vehicle, be sure to account for that. Conversely, energy-efficiency improvements can decrease the size of a planned array—although not necessarily at a cost-effective price. It's worth noting that you can't reduce your bill to zero; utilities charge connection/transmission/distribution fees regardless of electrical usage. My utility, for example, charges $19 per month ($228 per year).

Can solar survive without incentives?

The federal 30% tax credit for solar installations is due to expire at the end of 2016. Even if Congress doesn't agree on extending the tax credit (a strong possibility in the current political climate), states' policies could drive down the costs related to permits and inspections from multiple government departments and the utility company. According to a Department of Energy report, these "soft costs" add up to $2500 to the cost of a 5kw system. Removing this red tape—as Vermont has done with a one-page online application for all permits, will help drive down the cost of PV. (See how your state's connection policies rate at freethegrid.com.)

Will solar adoption continue to grow if Congress doesn't renew the credit? Yes, but smaller solar companies may be driven out of business. Solar incentives were introduced to help launch a fledgling industry; as the price of solar hardware has fallen, local incentives have been reduced. Whether in place or expired, these incentives have been remarkably successful. In California and Arizona, state and utility incentives have dried up, yet the rate of solar adoption has accelerated. A recent study by Greentech Media and the Solar Energy Industries Association (SEIA) found that in the first quarter of 2015, nearly 25% of all residential solar installations came online without any state- or utility-level incentive, up from 2% in 2012. If you're planning on taking advantage of the 30% federal tax credit, keep in mind that the system must be installed before December 31, 2016, and that, depending on the market, it can take from several weeks to several months from when the contract is signed until the system is energized. An unused solar credit cannot be carried over to 2017 if Congress doesn't renew the credit. □

Sean Groom is a contributing editor.

Drawing facing page: John Ueland

PV POWER TO THE PEOPLE

How much does a kilowatt hour of electricity cost? It depends on whom you ask. The fee that utilities pay to suppliers is one amount. Tack on transmission, connection, and distribution charges, and you've got the price consumers pay. What price do you assign to solar energy that homeowners put back onto the grid?

Utilities say solar costs them money

While the net-metering process isn't perfect, it's an effective way to time-shift production by allowing homeowners to "store" electricity on the grid. While there are critics of net metering among both PV supporters and utility companies, the troubling complaint for a prospective solar owner is from the utilities. Some utilities argue that PV customers are essentially free-riders, hopping on and off the grid when it suits them and shifting infrastructure and maintenance costs to nonsolar customers. In at least 20 states, utilities have requested to be allowed to levy additional charges specifically on customers with PV systems. So far, these requests have been rejected. The utilities are responding to a changing business model and declining revenues; as renewable-energy adoption increases, PV owners are not purchasing as much energy from the grid as the utilities predicted. Given the still very low national rate of PV adoption (less than 1% of households), however, the increase in household solar production doesn't account for falling revenue. In fact, data from the U.S. Energy Information Agency shows that electrical consumption has been falling steadily for years because of customers' energy-efficiency improvements.

Solar owners say they're underpaid for surplus

On the other side of the argument, PV owners and many policy advocates argue that net metering doesn't go nearly far enough in recognizing the value of PV to the grid. In places that pay for surplus production, the homeowners are likely to receive the avoided cost, or wholesale rate, for their electricity. Some solar advocates would rather see an accounting method that factors in all the avoided externalities of solar: avoided fuel costs for the utility, avoided greenhouse-gas emissions, avoided transmission costs, reduced need to use and build standby generation, reduced transmission losses, and avoided internalized emission costs. Several studies have created models for calculating the benefits of solar to the community of utility-rate payers. One study found a $92 million annual benefit to California; a similar study set the figure at $520 million annually in Texas.

A new paradigm?

Austin, Texas, and the state of Minnesota have each created an alternative to net metering that uses what's called a value-of-solar approach. In Austin each year, a consulting firm calculates a value for electricity generated by residential solar arrays by creating a price for the avoided externalities. Customers are billed for all of the electricity they consumed from Austin Energy during the billing period, and they receive a credit for all the electricity they generated. In 2015, the solar energy is credited at 11.3¢ per kwh. Excess credits are rolled over each month and don't expire. Minnesota adopted a statewide policy in 2014 requiring investor-owned utilities to offer a value-of-solar pricing tariff. The interesting difference between the Minnesota plan and the Austin plan is that in Minnesota, homeowners (the energy producers) sign a 25-year contract (the expected life of a PV system) with the utility guaranteeing the price for energy produced. The goal is to have utilities pay homeowners a transparent and market-based price for solar energy.

These two value-of-solar schemes are important to PV owners because they incorporate a price for pollution. Also, because the price is more than the wholesale cost of electricity, it undercuts utilities' claims that solar power fed to the grid is worth less.

Great porches

Earlier this year, I had the pleasure of speaking with architect and author Rick Pratt. As the chair and secretary of New Jersey's Hightstown–East Windsor Historical Society, Pratt contacted me for permission to feature a "Finishing Touch" piece from *Fine Homebuilding* in the society's newsletter. Since many of the historic homes in his community had newly restored porches or porches that needed to be restored, Pratt selected "Porch from the past" (*FHB* #238) to include in his May newsletter.

Pratt later shared with me photos from his own porch restoration. Knowing that building and restoring porches are favorite topics of *Fine Homebuilding*'s readers, I asked Pratt to invite members of his community to submit photos of their historic homes. Here are a few of their porches, along with a photo of what Hightstown looked like in the early 1900s.

—*Maureen Friedman*

A proper porch. *When Rick Pratt and Amanda Porter bought their house, it was the only one on Stockton Street without a full front porch. After seeing the facades around town that graced homes similar to theirs, Pratt designed and built this curved porch.*

For more photographs of Hightstown now and then, visit **FineHomebuilding.com/extras.**

Blast from the past. *Postcards from the Hightstown–East Windsor Historical Society show what the town looked like in the early 1900s. This image is of Stockton Street.*

THE BOROUGH OF HIGHTSTOWN

Hightstown is located in central New Jersey and is roughly equidistant from Philadelphia and New York City. The town traces its beginnings to 1747, when John Hight bought an 80-acre parcel alongside Rocky Brook. There he built a gristmill on what would become Main Street. The mill attracted other small businesses, and with the rise of train travel, the town became a transportation hub. Farms and homes spread across what is now the borough of Hightstown and East Windsor Township. The advent of the automobile, the retirement of the rail line, and the construction of the New Jersey Turnpike challenged Hightstown's role as a destination. With the establishment of the historic district and the downtown association, however, Hightstown is enjoying a rebirth as a treasure of America's past and present. In the summer of 2015, it was designated a Preserve America Community by the federal government. Hightstown will be featured in "Discover Our Shared Heritage" National Register Travel Itineraries as well as in the "Teaching With Historic Places" curricular materials created by the National Park Service.

The street where it all started. *The perfect spot to watch the world go by is in a rocking chair on the porch of this beautifully shingled and painted home on Main Street.*

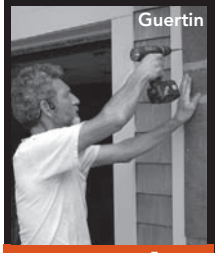
Light and bright. *The wraparound porch on this sunny yellow home on Morrison Street practically begs passersby to stop and sit for a spell.*

Patriotic porch. *This Stockton Street porch wraps two sides of the house, which continues the porch's red, white, and blue color scheme.*

Photographs courtesy of Rick Pratt, AIA, OGP Architects, Hightstown, N.J. (ogp-architects.com), and the Hightstown–East Windsor Historical Society (hewhs.com)

ask the experts

YOUR QUESTIONS—PRO ANSWERS



experts

Senior editor **Andy Engel** is a former carpenter and builder as well as the author of two Taunton Press books: *Building Stairs* (2007) and *Carpentry Complete* (2012).

Editorial adviser **Mike Guertin** is a builder and remodeler who has written over 100 articles for *Fine Homebuilding* and appeared in dozens of videos.

Need help?

Get answers you can trust from the experienced pros at *FHB*. Email your question to Experts@FineHomebuilding.com.

Attaching a deck

Q I'm designing a deck off a house whose floor joists are perpendicular to where the deck joists will run. I'm concerned that tying the deck into the rim board will put an excessive load on it. Would it be better to build a free-standing deck by adding another support beam, posts, and piers up close to the house?

—LISA MARIE LONDON
via Facebook

A The deck ledger can be connected to the rim board on the side of the house where the house joists run parallel to the rim board and perpendicular to the deck joists. There's no need to install another set of footings and another beam to support the deck at the house side—unless you prefer that method.

To attach the ledger to the house, you can use ½-in. lag screws or ½-in. lag bolts, following the IRC's (2009-2015) prescriptive fastener schedule. You also can use proprietary structural screws such as Fasten Master's LedgerLoks, Simpson Strong-Tie's SDWS or SDWH screws, or GRK's RSS screws, following their fastener schedules. In addition to securing the ledger using bolts or screws, install at least two lateral-load connectors between the deck joists and the house's floor framing. If you follow the IRC's design for lateral-load connections, you'll need to install joist-depth blocks between the rim board and the first floor joist and between the first and second floor joists. Framing angles such as Simpson Strong-Tie's A35 can be used to attach the blocking. Blocking provides anchor points for attaching tension-tie lateral-load connectors, which can be either Screw Products' DeckLok, Simpson Strong-Tie's DTT2Z, or USP's DTB-TZ. (Simpson's DTT1Z lateral-load connectors can't be used where the house joists run parallel to the rim board.) —*Mike Guertin*

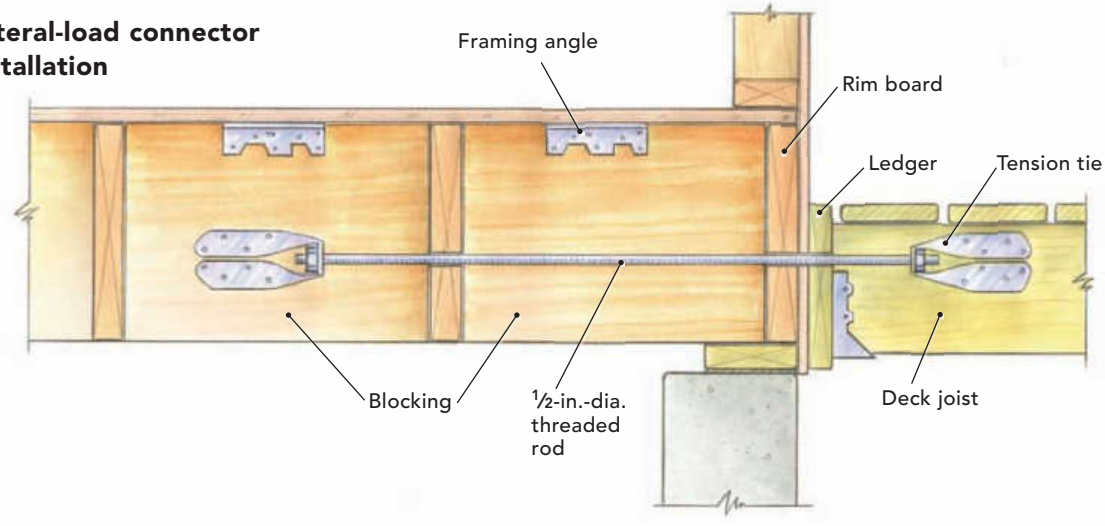
Site planning

Q I plan to build on a waterfront lot that is over an acre in size but only 115 ft. wide. There is a steep grade from the road to the building area, and the ground has yet to be cleared. Should the driveway be installed before or after the location of the septic system is determined?

—BRIGITTE
via Facebook

A Before breaking ground, have a site plan developed by an engineer who specializes in site work or by a land surveyor. The site plan will take into consideration setback distances, topography, and other issues, avoiding conflicts on the narrow property that could possibly require rerouting the driveway or repositioning the septic tank and/or leach field. Walking the property with the engineer or surveyor will provide an opportunity to discuss options. —*M.G.*

Lateral-load connector installation



Photos this page: *FHB* staff. Drawings: Dan Thornton.

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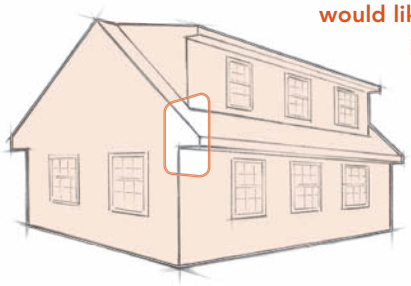
Cape dormer eave



Q I'm going to add a dormer to my Cape-style home in plane with the exterior wall and would like to continue the original eave line across the bottom of the dormer to break up the wall. What is the best way to frame this overhang?

—ROBERT JOHNSON
Springfield, Mo.

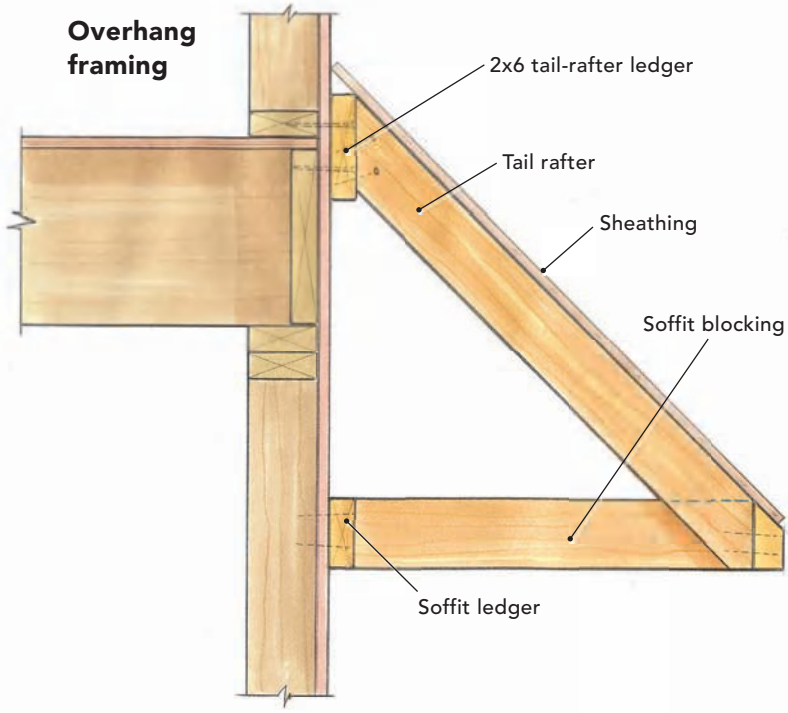
A When you frame the new dormer wall, continue the structural wall sheathing over the floor-joist area so it is flush with the sheathing on the wall below. This provides a flat surface for mounting the eave ledgers. Joints in the wall sheathing are vulnerable locations for air leakage, so seal any joints before framing the eave overhang.

Snap chalklines for a tail-rafter ledger and a soffit ledger. Provided the eave overhang is less than 2 ft., you can use 2x4s for framing the tail rafters rather than the original rafter stock size. A 2x4 tail rafter needs a 2x6 ledger for nailing support. The soffit framing can be either 2x3 or 2x4, so match the soffit ledger size to the framing material you choose.

One of the main forces acting on the eave overhang is the tension trying to pull the tail-rafter ledger off the wall, so mounting it securely is critical. Code allows for using nails, but I recommend using 5-in.-long FastenMaster HeadLok or Simpson Strong-Tie SDWS structural screws to fasten the tail-rafter ledger into the framing. The washer-head style of these screws lets them lie flush on the ledger so they won't interfere with tail-rafter placement. The soffit ledger isn't subject to the same forces and so can be nailed in place.

Toe-screw the tail rafters to the ledgers, and then nail the roof sheathing about 8 in. on center to the rafters and the ledger. The soffit blocking can be nailed to the soffit ledger. —*M.G.*

Overhang framing



Is sheathing structural?

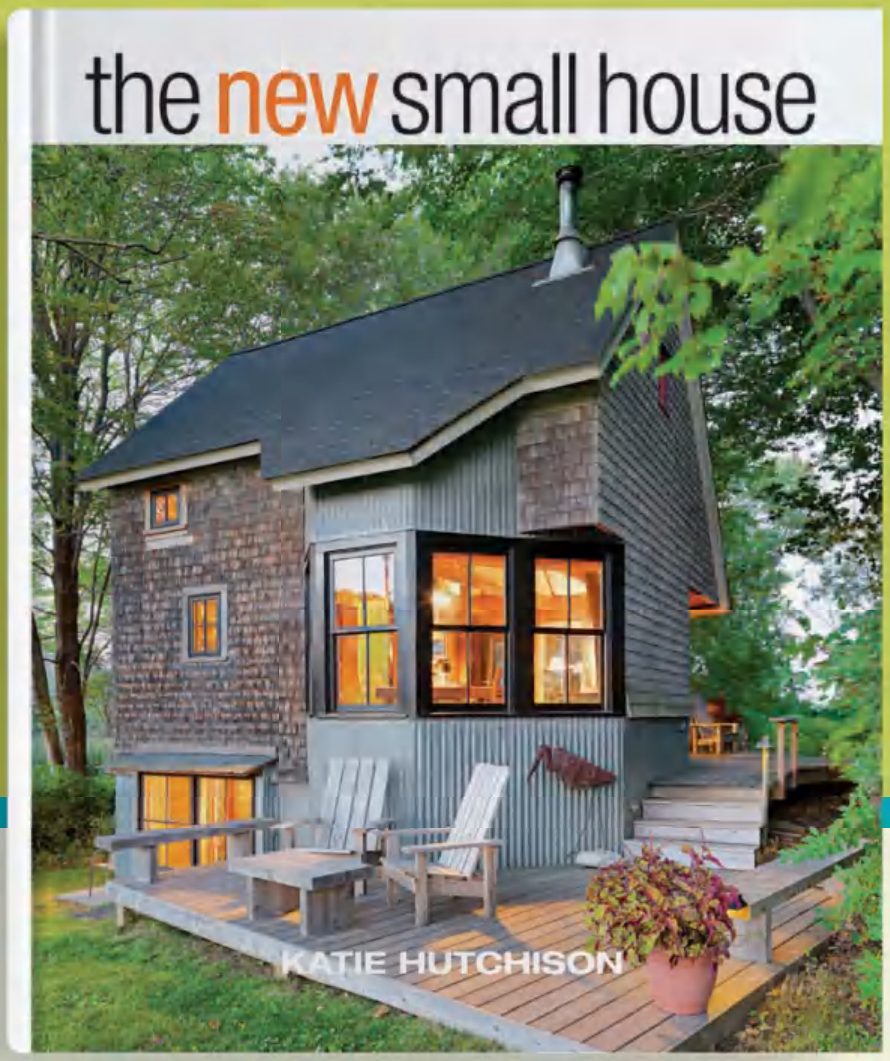
Q A licensed contractor told me that framing alone gives structural integrity to a house. I know that sheathing ties the framing together, but does it play a role in the building structure itself?

—WENDY FRECKER
via Breaktime

A Except in the case of timber frames with integral diagonal bracing, or in the now-unusual case of stud walls with let-in diagonal bracing, exterior sheathing

is what provides wood walls with enough rigidity to prevent them from toppling over with the first breath of wind or the rumble of an earthquake. Structurally, exterior sheathing is so important that its composition, orientation, and fastening schedule are dictated by building codes. Additionally, exterior sheathing provides a barrier to keep exterior air out of the wall insulation, greatly improving its ability to keep heat in during the winter and out during the summer. —*Andy Engel*

Photo this page: Daniel S. Morrison.



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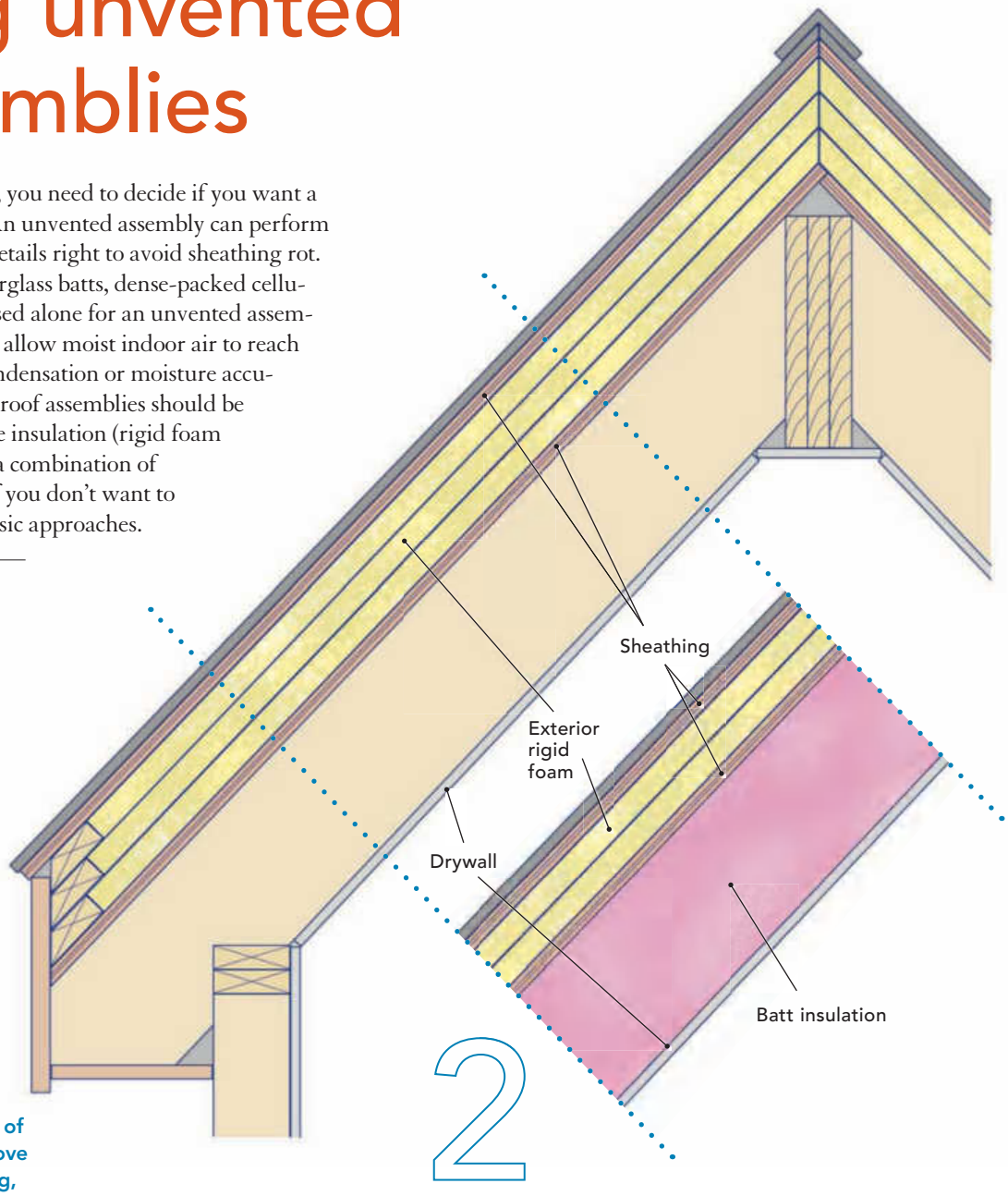
BY MARTIN HOLLADAY

Insulating unvented roof assemblies

If you plan to insulate a sloped roof, you need to decide if you want a vented or an unvented assembly. An unvented assembly can perform well, but it's important to get the details right to avoid sheathing rot. Air-permeable insulation such as fiberglass batts, dense-packed cellulose, or blown-in fiberglass can't be used alone for an unvented assembly, since these types of insulation can allow moist indoor air to reach the cold roof sheathing, leading to condensation or moisture accumulation in the sheathing. Unvented roof assemblies should be insulated either with air-impermeable insulation (rigid foam or spray polyurethane foam) or with a combination of foam and air-permeable insulation. If you don't want to use SIPs or nailbase, there are four basic approaches.

Martin Holladay is a senior editor.

FOUR OPTIONS FOR BUILDING AN UNVENTED ROOF ASSEMBLY



1 Rigid foam above roof sheathing

You can install all of the insulation above the roof sheathing, but the foam has to be thick enough to meet minimum code requirements for ceiling R-value. The rigid foam will be fairly thick (see "How much insulation?" facing page).

2 Rigid foam on roof sheathing with air-permeable insulation between the rafters

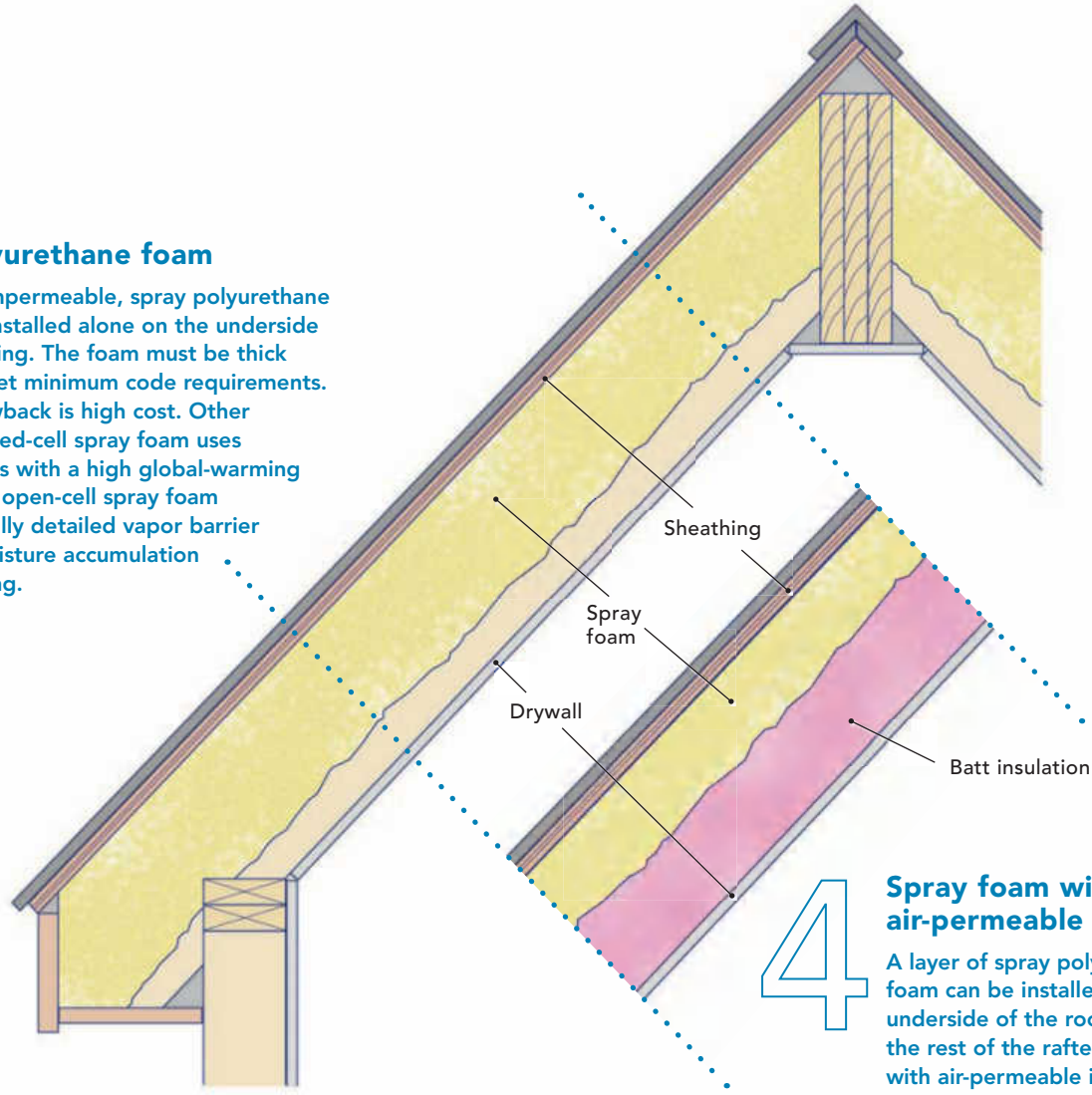
Rigid foam also can be installed above the roof sheathing in tandem with air-permeable insulation between the rafters. In this case, the rigid foam can be thinner than when it's used alone. Code specifies the minimum R-value of the rigid-foam layer.

Drawings: Dan Thornton

3

Spray polyurethane foam

Since it's air impermeable, spray polyurethane foam can be installed alone on the underside of roof sheathing. The foam must be thick enough to meet minimum code requirements. The main drawback is high cost. Other concerns: Closed-cell spray foam uses blowing agents with a high global-warming potential, and open-cell spray foam needs a carefully detailed vapor barrier to prevent moisture accumulation in the sheathing.



4

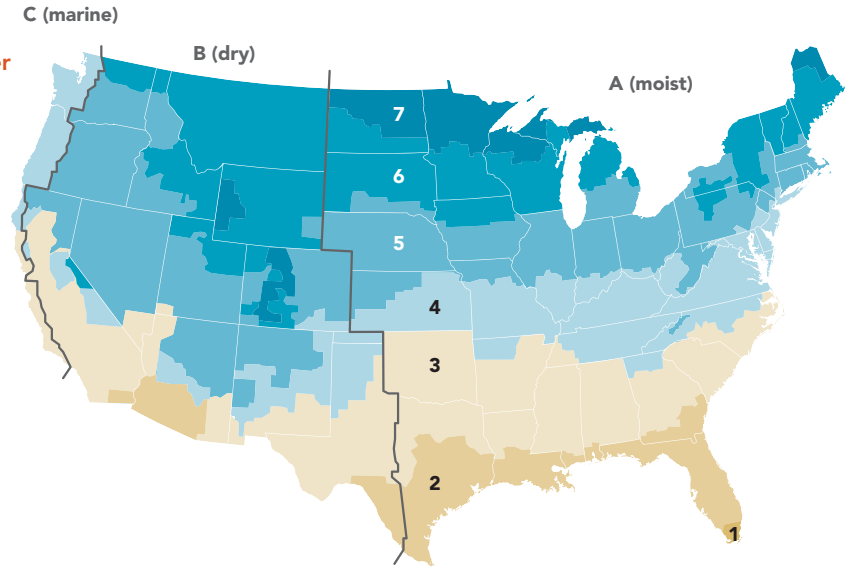
Spray foam with air-permeable insulation

A layer of spray polyurethane foam can be installed against the underside of the roof sheathing, with the rest of the rafter cavity filled with air-permeable insulation. You must meet the same minimum code requirements for the spray-foam layer and the total assembly as for the rigid-foam-plus-air-permeable-insulation approach.

How much insulation?

Most building codes include a table showing minimum R-value requirements by climate zone. Insulation, whether a single type or combination, must at least meet these requirements. When combining foam and air-permeable insulations, code requires the foam layer to meet specific minimum R-value requirements, which vary by zone. This chart is based on table R806.5 of the 2012 IRC.

Climate zone	Air-impermeable insulation	Minimum total R-value
1, 2, 3	R-5	R-30
4a, 4b	R-15	R-38
4c	R-10	R-38
5	R-20	R-38
6	R-25	R-49
7	R-30	R-49
8	R-35	R-49



BY ANDY ENGEL

Using a drywall router

For years, I avoided using a drywall router to cut holes for electrical boxes, lights, windows, doors, and so forth. To use this small tool, you hang the sheet, make a plunge cut with the ⅛-in. self-guided helical bit, and follow the edge of whatever it is you want to fit the sheet around. I'd tried one on a few occasions, with results such as mangled wires and overcut drywall. I reverted to doing things the carpenter's way: laying out the holes with a square and a tape measure, then cutting them with a knife and a keyhole saw. This was slow, but at least I was on familiar ground.

Still, every drywall pro I knew used routers to make quick, clean, and accurate cuts. There had to be something to these tools. They don't cost a lot either (about $60 to $110), and the bits are only a buck or two each. Tool use usually comes easily to me, so my failure with drywall routers was both out of character and frustrating. And I wasn't alone; many carpenters I've talked with are buffaloed by these tools.

When faced with a big project of my own, I finally decided to figure it out. After a few missteps, I'm cutting holes in drywall faster and more accurately than ever. Here's what I learned.

Senior editor Andy Engel is the author of Carpentry Complete *(The Taunton Press, 2012). Photos by Rodney Diaz, except where noted.*

STEP BY STEP

1 ***Set the bit depth.*** *The tip of a drywall bit is smooth, so it can bear on the edge of whatever you're cutting and guide the cut. Set the bit depth so that the smooth section will be about ⅛ in. beyond the back of the drywall.*

2 ***Mark a starting point.*** *For cuts near an edge, mark the abutting sheet. For middle-of-the-board cuts, mark the center of the cutout before hanging the board. This is a starting point and a reminder that something is there to cut around.*

3 ***Don't mangle wires.*** *Most of what gets cut out with a drywall router are electrical boxes, and that spinning bit can seriously damage wires. Make sure the power to the box you're cutting around is off, and push wires to the back.*

4 ***Hang the board.*** *Don't screw near what you're cutting out. Fasten too closely, and the pressure on the sheet can tear the paper face as the cut is finished. Finish fastening after completing all cuts.*

5 ***Take the plunge.*** *Push on the sheet with your hand or knee so that the drywall is tight to the object you're cutting out. Turn on the router, and push the bit through the drywall.*

6 ***Make the leap.*** *Move the router outward until the bit hits an edge of what you're cutting out. Pull the bit out, then reinsert it on the far side of the edge.*

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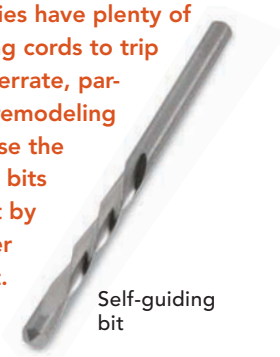
Makita XOC01
$109 ($304 for kit with two batteries)

RotoZip SS355
$63

Drywall routers and bits

The RotoZip is the granddaddy of drywall routers, so much so that the job-site term for a drywall router is a RotoZip. A number of companies now make drywall routers, however, and there are even cordless versions, such as Makita's XOC01, which I tried out on an earlier job. Both tools have their place. The RotoZip has more power, and because it's corded (the 6-ft. cord could be longer; drywall screwguns come with 16-ft. cords), there isn't a battery to run out of power, which makes it a better choice on a larger project. On the other hand, the Makita has enough power, the batteries have plenty of life, and not having cords to trip over is hard to overrate, particularly on tight remodeling jobs. Both tools use the same ⅛-in. helical bits that guide the cut by riding on whatever you're cutting out.

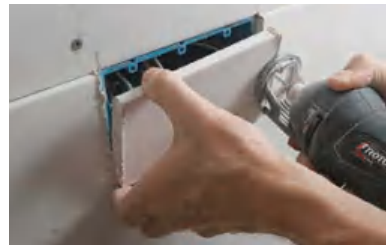


Self-guiding bit

STEP BY STEP

7 ***Go counterclockwise on outside cuts.*** *Moving in this direction requires only light pressure to follow the box edge, as the bit rotation pulls it inward. If you cut clockwise on the outside, the rotation will push the bit away from the box, causing you to overcut.*

8 ***Take your time.*** *Slow the cut near corners, pushing the bit lightly against the object so that it turns as it reaches the corner. If the router stops moving easily, you may have hit a nib on an electrical box or a projecting piece of extension jam. Gently move the bit around the obstacle, then cut on.*



Go clockwise on inside cuts

Unlike recessed lights, electrical boxes, and windows with jambs that extend beyond the stud faces, rough openings are cut from their inside. Set the bit deeper so that the tip clears the eased edges of framing lumber, and cut clockwise.

Product photos: Dan Thornton

Call for Entries

It's almost a year away, but we're already scouting for our next *Kitchens & Baths* annual issue. We're interested in brand-new or recently remodeled projects of every style from all over the country. And we're not looking only for big, luxuriant kitchens and baths; well-designed projects done on a tight budget are dear to our hearts. But big or small, expensive or thrifty, they must be highly functional and beautifully crafted.

Send us decent color images and a brief description explaining which aspects of your project might prove interesting to our readers. We prefer online submissions at **FineHomebuilding.com/kitchen-bath-submissions**. We are also happy to receive email submissions at fhcallforentries@taunton.com (7MB maximum file) or to review CDs or hard copies of your materials, which you can send to *Kitchens & Baths*, *Fine Homebuilding*, 63 S. Main St., P.O. Box 5506, Newtown, CT 06470-5506.

Entries deadline
February 12, 2016

The Taunton Press
Inspiration for hands-on living®

Photo: Whit Preston

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BY BUD DIETRICH

Pinch points

Many production builders in the 1970s, '80s, and '90s minimized construction costs by keeping the size of their houses as small as possible while still trying to include all the features that attract buyers. The result has been a fixation on room count while ignoring whether these rooms function as they should. We end up with houses that are filled with so-called pinch points, which fight us at every turn. Many want to solve the problem by building an addition, assuming that more space is the answer. But the better answer lies in reshaping the space that's already there.

While these pinch points can occur throughout the house, I focus here on the main floor. The first of the two floor plans illustrates the problem areas, and the second provides some solutions.

Bud Dietrich is an architect in New Port Richey, Fla.

COMMON PINCH POINTS can be found in many house styles, but the two-story neocolonial is a prime example. These houses adapted the traditional colonial style to new technologies and lifestyles. For example, detached garages became attached, and the family room was introduced to accommodate the now-ubiquitous television. As these changes appeared, the older functions of the formal living room and formal entry remained, even though these spaces were less important in the life of the family.

1 Too-small laundry/mudroom/entry

As the garage became the primary entry, the laundry/mudroom became one of the worst pinch points in the house. Rarely more than 5 ft. wide, this room is too small to allow orderly removal and storage of coats and shoes, or for setting down groceries or other items making their way from the car to the house. The situation is complicated further by the need to open one door and then another to progress into the house.

2 Diminutive dining room

The formal dining room is still, and likely will remain, a part of any house built today. Too often, though, the dining room is built just large enough for a table, a breakfront, and a china cabinet and is too small when the table is expanded to accommodate guests.

3 Small hall with dueling doors

Many people, and certainly most visitors, enter a home through the front door or the back door, presenting problems similar to those in the laundry/mudroom entrance. Often there isn't enough space to shed layers of clothing, put down groceries, or welcome a guest. Moreover, it's not uncommon for the doors to the basement, the coat closet, and/or the powder room all to open into the entry area, creating traffic jams and doors that interfere with each other. Even if the entry is adequately sized, it can feel too tight if a person has to close one door in order to open another.

4 Triangulated kitchen

A staple of kitchen design for many years has been the so-called work triangle. The sink, the range, and the refrigerator form the points of this triangle, with no more than 9 ft. between them. Although fine for a larger kitchen, this concept doesn't work well in the smaller kitchens that resulted from having to include mudrooms and family rooms in the floor plan. In these kitchens, it's difficult for two cooks to work together, and collisions occur as others squeeze into the triangle to get a glass of water or dispose of something in the trash.

Drawings: Bud Dietrich

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FIXING PINCH POINTS requires an understanding of how people move through the house and how they use each room. This means increasing the size of rooms that have been shortchanged while decreasing the size of rooms that are too big for their actual use. It also means looking at the location of doors and doorways and considering relocating rooms that would function better elsewhere in the floor plan. Although a large addition usually won't do much to cure a home's existing pinch points, a small bump-out in the right location can make a huge difference.

1 A functioning laundry/mudroom/entry

Fixing this room starts with making sure it's sized so that at least two people can occupy the space without stepping on each other. Here, stealing 3 ft. from the adjacent family room (now an office) would give occupants room to move and enough space for a bench and storage cubbies. A bump-out of the same size (shown) works also. Other options include stacking the washer and dryer and replacing a swinging door with a pocket door.

2 Expandable dining area

To allow room for large gatherings, the dining table is relocated from the too-small dining room to one end of the oversize living room. The remaining living-room space becomes a sitting room for reading or entertaining, unifying these two functions in one "formal zone." At the same time, a wall in the too-small, landlocked dining room is removed, creating a larger open space, or "casual zone," that includes a table for eating or playing games as well as an area for gathering or watching TV. Establishing these two separate zones enables a casual lifestyle that doesn't interfere with the formal spaces where guests are entertained. A happy by-product of this reorganization is the reassignment of the former family room as a home office.

3 More spacious hallway

With outerwear relegated to the mudroom, the coat closet can be eliminated to free up floor space and to keep guests clear of traffic coming down the stairs. Adding a pocket door on the powder room eliminates collisions with the basement door opposite.

4 Reshaped kitchen

Kitchens have evolved from being the domain of one family member to a place where the entire family gathers while meals are prepared and cleanup is underway. This has made the kitchen island the focus. Here, an island is both a place for folks to gather and an architectural element that directs traffic around and away from the chef's working area. This eliminates the pinch point of the dysfunctional triangle and, because the island is lined up with the mudroom entry, makes bringing groceries into the house much easier.

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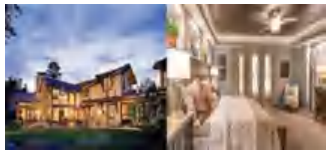

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INTERVIEW BY AARON FAGAN

CHARLIE MYERS, Vo-tech teacher This educator at the Woonsocket Area Career and Technical Center in Rhode Island prepares students to pursue the trades and more.

How did you get started in vo-tech?

I remember being bombarded in high school about how you can only be successful if you go to college. Naturally, I wanted to be successful. I was enrolled in a machine-shop class at a vo-tech school, with plans on getting an engineering degree. My goal was to design machines that made machines. I took college-prep classes and graduated, but college tuition was totally out of the question. Instead, I started an entry-level job in a cabinetmaking shop.

Soon after, I took on a few framing side jobs and found a passion. I created a plan to start my own framing company. I loved that there was so much to learn. I read all kinds of books about carpentry and dozens of industry trade magazines, but I realized that what I really looked forward to was helping new hires learn the ropes. I'd spend my lunch break showing them how to lay out walls or square a foundation, or after work, I would show them how to calculate and lay out rafters. I looked into the requirements for becoming a construction teacher, and I attended college at night. After earning my degree, I began teaching in an urban school system. I'm able to relate to students because I know about the financial circumstances a lot of them are facing.

I understand that your students have done well in the Skills USA competitions.

Our students have won many state medals, and I'm extremely proud of every single one who makes it to the national competition. They put it all on the line and work for months in preparation. When we do have a state winner, I attend the national competition with them in June. Words cannot do it justice. The main floor is the size of nine football fields. It's a massive celebration of the hard work the students put in to get there. I always return loaded with new ideas for my curriculum.

Is there still a social stigma to vo-tech education?

That stigma is all too familiar from the era when I attended a vo-tech school. The technical courses were challenging, but the academic courses were not, which severely limited choices upon graduation.

Things couldn't be more different now. Graduates from our school have gone on to the most prestigious colleges in the country—including Harvard, Princeton, Yale, and Georgetown—as well as local schools such as the University of Rhode Island, New England Tech, and Johnson & Wales University. The statistics for the vo-tech model are staggering. According to *Education Weekly,* "Nationally, 90% of the students enrolled in a vo-tech program graduate on time." Vo-tech students who continue on to four-year colleges are almost twice as likely to graduate on time as liberal-arts students, which is a tremendously positive change. Prospective students often have to convince their parents to let them come here, but our open-house events allow us to showcase options that are available to their children *because* they attend this school. We really are a school of choice, where students discover what excites and interests them. Many students have had internships, participated in job shadowing, and ultimately obtained full-time work because of doors we've helped open. We have graduates who have pursued trade work in every facet of construction. Conversely, some have realized that the hands-on element was not for them and pursued related careers such as teaching, architecture, or a variety of engineering disciplines. For each of these students, their background in construction helped them to identify their career path and succeed in pursuing it.

> **Vo-tech students who continue on to four-year colleges are almost twice as likely to graduate on time as liberal-arts students.**

What kind of experiences do your students get?

It's my goal to get them out of the classroom and onto a job site as often as possible. Qualified students earn NCCER apprenticeship hours, which can transfer to colleges for credits; OSHA 10 cards and S/P2 safety certifications; and up to four ICC certifications. In addition, we are working statewide to be the first program in the country to offer students a lead-abatement class, where they can earn their Lead-Safe Remodeler/Renovator license. The students also learn about green building; in fact, we became the first program in Rhode Island to build an Energy Star home. We built a home to Earth Advantage Standards, and we are planning a new partnership with the city of Woonsocket to plan, develop, and construct the first student-built, net-zero home in our state.

I bring building science and principles into our curriculum and disprove the myth that building an energy-efficient home means upping construction costs. It's an educated means of understanding how to build a better home that will last longer and be healthier for the customer.

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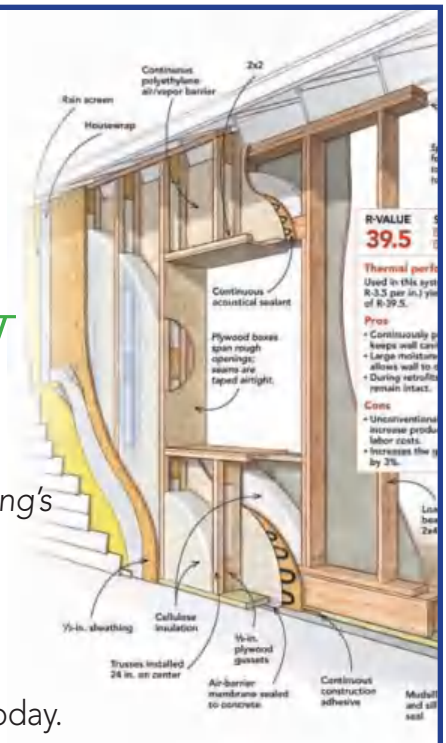

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		Average no. copies of each issue during preceding 12 months	No. copies of single issue published nearest to filing date
A.	Total no. copies	258,664	253,679
B.	Paid circulation		
	1. Mailed outside-county paid subscriptions	116,067	115,965
	2. Mailed in-county paid subscriptions	0	0
	3. Paid distribution outside the mail	35,327	37,779
	4. Paid distribution by other classes mailed through the USPS	0	0
C.	Total paid circulation	151,394	153,744
D.	Free or nominal rate distribution (by mail and outside the mail)		
	1. Outside-county as stated on Form 3541	9,347	9,433
	2. In-county as stated on Form 3541	0	0
	3. Other classes mailed through the USPS	0	0
	4. Free or nominal rate distribution outside the mail	0	0
E.	Total free or nominal rate distribution (sum of 15D1, D2, D3, D4)	9,347	9,433
F.	Total distribution	160,741	163,177
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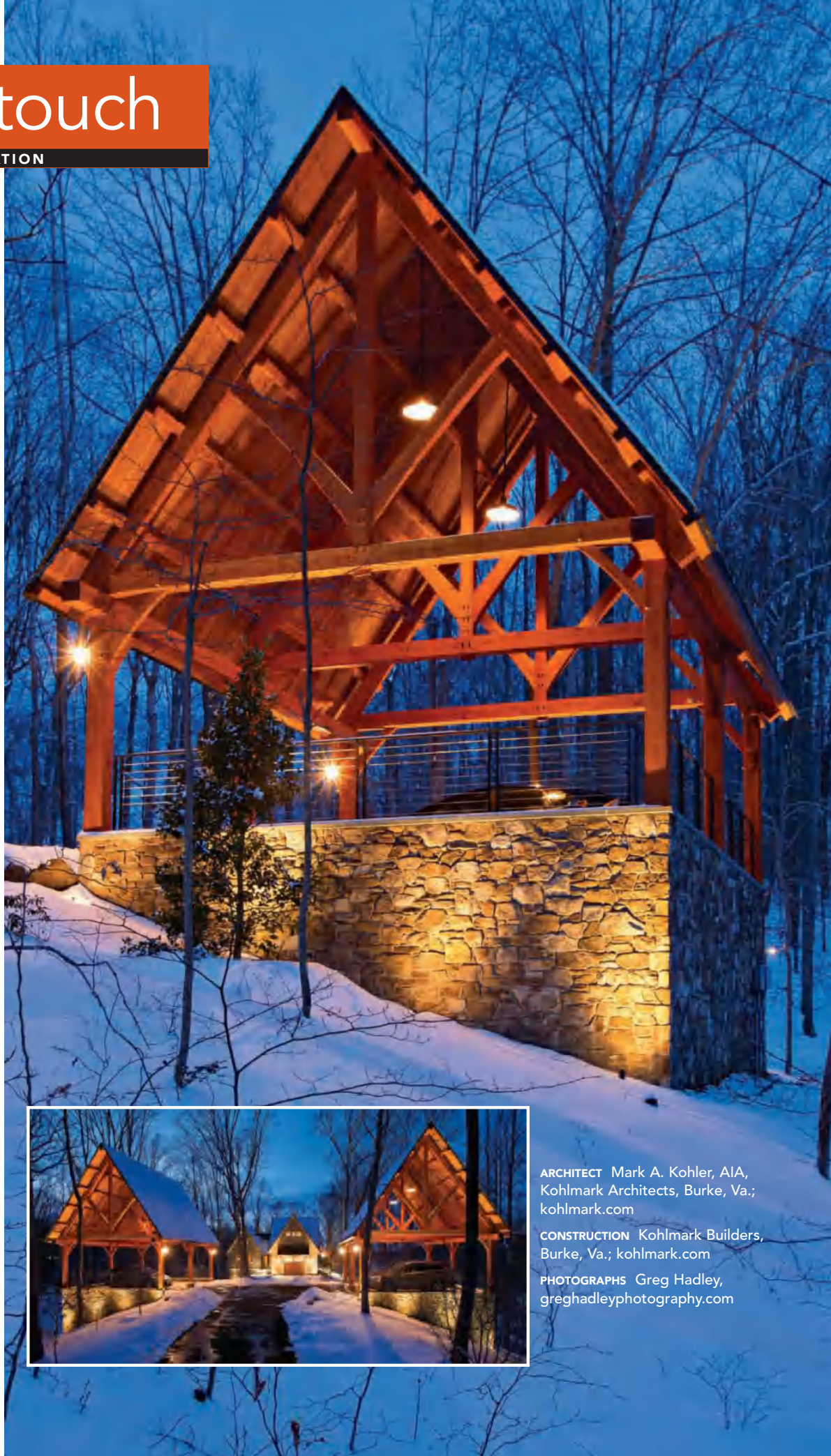
H.	Total	258,644	253,679
I.	Percent paid circulation	94.2%	94.2%

16. (no electronic election) **17.** This Statement of Ownership will be printed in the December 2015/January 2016 issue of this publication. **18.** Signature and title of Editor, Business Manager, or Owner: I certify that all information furnished on this form is true and complete, Dan McCarthy, CEO, The Taunton Press Inc.

Parallel parking

June and Mark Kohler found a lot to love about the property they purchased to build their home. Its parklike setting with commanding views of a reservoir was breathtaking, and it was conveniently located about half an hour from both Washington, D.C., and Mark's office. But the site also had what most people would consider a serious disadvantage: its location on a high ridge with a 45° slope to the water on the right and a deep ravine on the left. A practicing architect since 1984, Mark was up to the design challenge. To minimize the impact on the sensitive site, very few trees were removed, grades were not changed, and the home was designed to take full advantage of the natural topography. The lack of level surfaces on which to park cars led Mark to design twin parking pavilions. Soil excavated for the basement provided the necessary backfill to create the foundations. The open, timber-frame construction and use of natural stone enhance the home, preserve the water views, and allow the pavilions to blend in among the trees. The symmetrical design of the pavilions and their placement frame the house, provide visual balance, and create a dramatic entrance. Beyond parking, the pavilions are also intended as spaces for family gatherings, nature viewing, and any outdoor endeavors that require some protection from the elements. They are equipped with water, electricity, lighting, and a hidden backup generator.
—Maureen Friedman



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